Electrical Review

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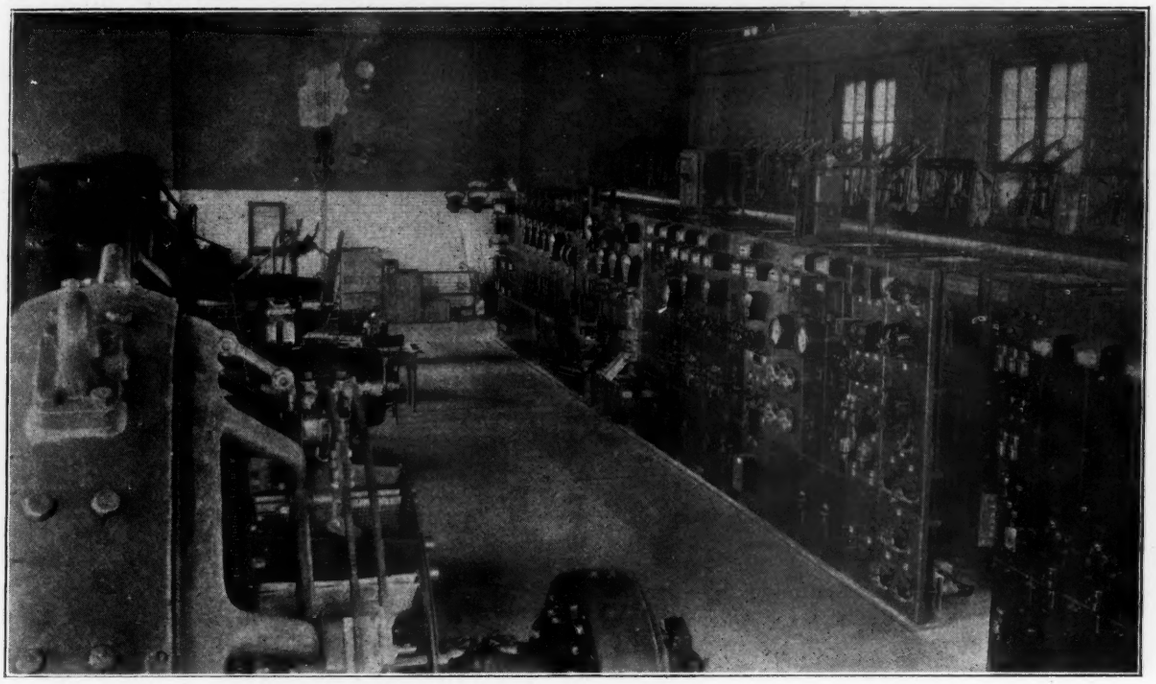

Switchboard and Machines in Tunnel Substation of Michigan Central Railroad.

Electrical Apparatus Development During 1920

Equipment Completed, Designed or Started During Past Year by General Electric Co. — Progress in Industrial Applications, Mining, Transportation and Illumination—Further Advances Indicated

By JOHN LISTON

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The outstanding feature of the electrical industry throughout a large part of the past year was the unprecedented volume of production attained, the impetus of the re-awakened demand for electrical apparatus which became intensified in the latter part of 1919 being well maintained through the first nine months of 1920. Under these conditions development work was confined largely to detailed improvements in the mechanical and electrical characteristics of standard apparatus, most of the changes effected being along the lines of normal design. There were also a number of new applications and combinations of existing apparatus and some developments which represent a distinct advance over previous practice. Higher potentials in transformers actually installed, and a further advance of this nature undertaken in construction in progress at the close of the year make possible the commercial use of higher voltage transmission than has heretofore been practicable.

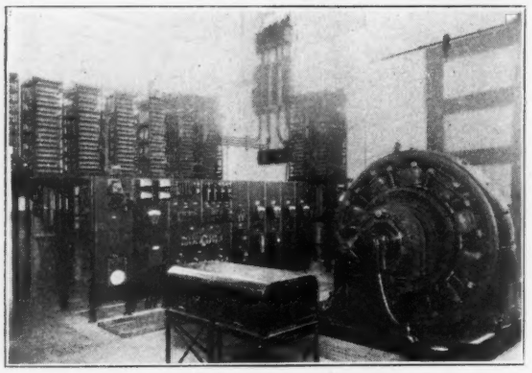
In the central-station field developments were largely along the lines of extending or completing existing stations and, in spite of adverse financial conditions, orders were placed for a large number of machines of 20,000-kw. capacity and greater. These machines are of the single-cylinder design similar to those already in successful operation. The demand for the intermediate and smaller sizes of turbines was greater than in any previous year.

Already merchant ships have been and are now being fitted with electric propulsion machinery, and the first electrically propelled cargo

ship, the S. S. *Eclipse* owned by the United States Shipping Board, and the first American electric passenger and express ship, the S.S. *Cuba* of the Coast Steamship Co., have had successful official trial trips.

Application of Electric-Propulsion Machinery in Marine Work.

Two types of electric ship-propulsion machinery are available—the induction-motor and the synchronous-motor drive. Eleven more sets for induction-motor drive are being built now for the Emergency Fleet Corp. to be installed in cargo



Automatic Substation for Railway Service—1,500-kw. Synchronous Converter.

ships and four sets for synchronous-motor drive are to be installed on the latest United States coast-guard cutters. The propulsion equipments for the Emergency Fleet Corp. consist of a marine turbine-generator set comprising a 3000-hp., 3000-r.p.m. Curtis steam turbine direct-connected to a three-phase, a-c. generator of 2300 volts, supplying power to an induction motor of 100 r.p.m. which is direct-connected to the propeller shaft. Two separate engine-driven generating sets furnish excitation current for the main generator, one of these being held in reserve as a spare. The equipment of the United States coast-guard cutters consists of a 2600-hp. turbine generator, a 130-r.p.m., 2300-volt synchronous motor, a control group and panel, and two 75-kw., d-c. turbine-generator sets for excitation and auxiliary power purposes.

The decision of the Navy to water cool the main propulsion generators and motors for a number of the new capital ships is very important from an engineering standpoint. The cooler cores will be of the fin and tube type, similar to automobile radiators. Sea water will be circulated through the coolers and the ventilating air from the machines will be driven through the coolers, thus transferring the heat losses to the sea.

Progress in Development of Railroad Electrification.

The propelling machinery for three battleships and four battle cruisers which is now under construction has a greater aggregate capacity than that of any single group of machines ever produced for this class of work. There are included 22 turbine generators ranging in unit capacity from 11,000 to 35,000 kw. with a total capacity of 682,000 kw., and 44 propelling motors of the form-wound rotor induction type with speeds from 170 r.p.m. to 320 r.p.m. and individual ratings from 7000 to 22,500 hp., the aggregate capacity being 868,000 hp.

The most notable activities in the electric-railway field during the year were in connection with the safety car, automatic substations and steam-railroad electrification. The safety car has become more nearly a standard design, and large numbers are being ordered for congested city service as well as for the lighter and less frequent schedules in the smaller towns. Additional automatic control equipments for railway-substation service, ranging in size up to 1500 kw., were ordered by many roads during the year. The 2000-kw. motor-generator set with complete automatic control furnished for the Detroit river tunnel electrification has been in successful operation for several months. This is at present the largest automatically operated single unit in railway service.

What is probably the largest single order for automatic substation equipment included eight 1000-kw. control equipments and transformers to be installed in a 1500-volt d-c. substation at Melbourne, Australia.

In the United States work on the electrification of the steam railways was confined to the Chicago, Milwaukee & St. Paul Pacific Coast extension, which is now operating entirely with electric locomotives. The five gearless engines which handle the main-line passenger trains over this section have operated without interruption since being put in service in the spring of 1920.

Electrification of Foreign Railroads Shows Much Progress.

The most prominent electrifications which are now actually under way are for the Paulista railway in Brazil and the Montreal harbor commission at Montreal. The Paulista railway equipment includes eight 100-ton freight locomotives and four 120-ton passenger locomotives designed for operation on a 3000-volt overhead trolley with regenerative braking features for the heavy grade service, a complete 3000-volt d-c. substation of 4500-kw. capacity, overhead line material, bonds and transmission line material.

The Montreal harbor commission during the year made considerable progress in electrifying the terminal trackage around Montreal harbor. These lines extend a distance of about 17 mi. on both sides of the St. Lawrence river, and are located at the head of ocean navigation and at the foot of inland navigation through the Great Lakes. There is a total of 58 mi. of track extending along the water front and connecting the piers. Connection to the several steam railroads is also included.

The 2400-volt d-c. system was selected for this service after the successful demonstration of the Canadian Northern railway lines through the Mount Royal tunnel. The overhead equipment is similar to that used by the Montreal tunnel, the working conductor being of 4/0 copper wire suspended by loop hangers at the height of 23 ft. above the rail. At present two of the 83-ton, 2400-volt locomotives originally built for the Canadian Northern railway are being used temporarily for switching service on the finished

portion of the line. A 2400-volt d-c. substation is under construction which will contain three 1000-kw. motor-generator sets.

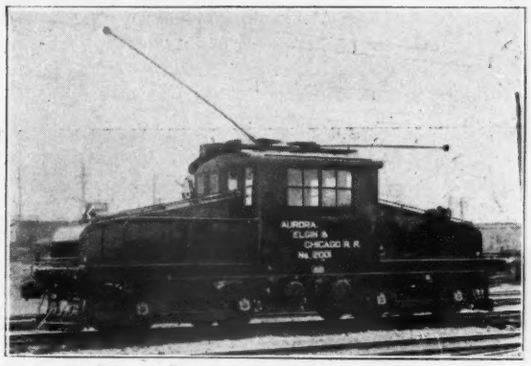
Early in the year a new type of gathering locomotive was produced. The important items in the new locomotive were a new type of controller by means of which positive and graduated electric braking is secured, the use of outside frame construction, journal leaf springs provided with an equalizer bar, demountable tires for the wheels and an improved cable reel.

Two 40-ton storage-battery locomotives were constructed for general industrial and switching service. They are double-truck units and are provided with four battery-type motors for 200-volt operation by means of a 950-ampere-hour battery. These two locomotives can be coupled together to form a single 80-ton unit which can be controlled in the same way as either locomotive separately.

Alternating-Current Machines Constructed in Large Sizes.

Some of the large units under construction a year ago were completed and installed early in 1920. Among these is the 30,000-kv-a., 600-r.p.m., 6600-volt synchronous condenser which is now operating in the Eagle Rock substation of the Southern California Edison Co., and which still represents the maximum capacity for machines of this type. The 12,500-kv-a., 22,000-volt synchronous condenser was completed for the Andhra Valley Power Supply Co. of Bombay, India. This machine still represents the maximum voltage for synchronous condensers. The 32,500-kv-a. vertical-shaft waterwheel generator at Niagara Falls has been in successful operation for nearly a year. It is interesting to note that there is at present under construction a vertical-shaft machine with a rating of 40,000-kv-a. at 11,000 volts for operation at a speed of 138½ r.p.m. This will represent the largest rating for vertical-shaft waterwheel generators in the United States.

Two horizontal-shaft waterwheel generators of greater capacity than any previously constructed were completed during the year for the Great Western Power Co. They are rated at 22,223 kv-a. for 11,000-volt, three-phase, 60-cycle opration at 171 r.p.m.



Locomotive for 600-Volt Service.

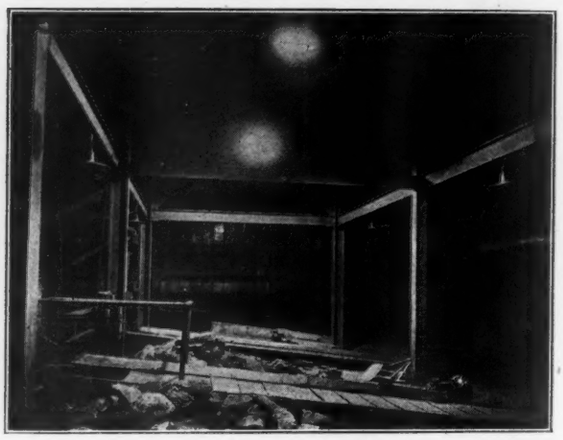
Another large horizontal-shaft machine for operation at exceptionally high speed was completed and tested. This generator is entirely inclosed and is rated at 18,750 kv-a. at 6600 volts and will operate at 600 r.p.m.

Three horizontal-shaft waterwheel generators of unusual mechanical design were constructed for operation under conditions where they would be liable to an overspeed of from 80 to 100% in case the load was suddenly removed and the governing mechanism failed to function. These machines are rated at 7000 kv-a. and 14,000 volts and operate at 750 r.p.m. Due to the small diameter of the rotor and the high peripheral speed of the poles a unique method of pole construction was adopted to insure the safety of the machine even under 100% overspeed. The rotor body and poles consist of a series of steel plates machined to shape. Each plate is slotted across the pole face at right angles to the shaft axis to receive the pole tip which is a separate steel bar machined to the shape of a pole tip. After machining and drilling the individual plates they were bolted together in two sections and these sections were again bolted together with through-bolts, the whole forming the revolving field without coils. The rotor complete was then shrunk onto the shaft.

A new line of slow-speed synchronous motors was developed primarily for driving air or am-

Park Lighting Installation at Saratoga Springs, N. Y.

monia compressors. Through a simplification of design and a standardization of parts it is possible to secure with four different frames 80 standard motor ratings and to minimize the



Picking Chutes at Coal Mine Lighted With 500-Watt Lamps.

quantity and cost of repair parts as well as the cost of production. These motors range from 150 to 600 hp. in capacity and operate at speeds of from 150 to 300 r.p.m.

In general there was an increasing demand during the year for synchronous motors for various industrial applications such as pumps, ammonia and air compressors, pulp grinders, Jordan engines, cement, flour and rubber mills and a great variety of other purposes.

A complete new line of four-pole compound-wound, commutating-pole, d-c. motors were brought out in capacities ranging from 2 to 15 hp. for operation on 230 and 550-volt circuits. These motors were designed primarily for the operation of reciprocating mine pumps and similar loads.

A large number of these motors have been operating mine pumps for nearly a year in locations where they were subjected to moisture, coal dust and acid fumes and have given satisfactory service.

Industries Continue Application of Electric Drive in Many Places.

The demand for oil-well motors continued to increase in both old and new oil fields, but the power companies were unable during most of the year to supply ample power for this purpose.

A new high record in the adoption of electric drive of steel-mill main rolls was made. Orders covering over 106,000 hp. (continuous rated) were placed, and of this total 29,400 hp. was made up of adjustable-speed a-c. motors equipped with regulating sets.

Among the large equipments purchased for foreign shipment that for the United Steel Co., Sheffield, England, is especially worthy of mention. This equipment includes three adjustable-speed induction motors with Scherbius speed control.

Activity in mining was not quite up to that of some former years, but a number of interesting large equipments and an unusually large number of small hoist motors from 100 to 250 hp. were installed or under construction at the close of the year. Among these were 97 units, totalling 27,150 hp., of which 59 units totalling 8900 hp. were in the smaller capacities. The McKinney Steel Co.'s hoist at Bessemer, Mich., was put into commission and has given a good account of itself. This is the largest d-c. iron-ore hoist in the United States. The drums are cylindrical and are driven by a 1650-hp., 80-r.p.m. direct-connected motor.

An 1800-hp., 360-r.p.m. hoist motor for No. 6 Muscoda slope for the Tennessee Coal, Iron & Railroad Co. is being built. This motor will be a duplicate of the one now in operation at the No. 4 Muscoda slope and will hoist 26,880 lb. of ore per trip from a maximum distance of 6000 ft. along the slope at an average inclination of 21 deg. from the horizontal.

The coal-loading pier of the Baltimore & Ohio Railroad Co. at Curtis Bay, Md., was improved by the addition of four electrically operated trimming machines. The trimming machine consists of a flexible and easily controlled telescopic chute which can be hung on the ram. At the bottom of this chute is a rotating mechanism which carries a power-driven conveyor. Coal passes down through the chute, strikes the rapidly moving belt conveyor, and is thrown in any desired direction from the open hatch into the cargo spaces of the boat. A trimmer will handle coal at the rate of 100 tons per hour and will throw it a maximum distance of 50 ft.

Electric Heating Equipment Expanded in Use and Application.

The developments in electric-furnace equipments were principally along the line of largely increased use. The increase in the number of electric-furnace regulators placed in operation during 1920 over all previous installations was about 25%, a figure that clearly indicates the steadily increasing confidence in this type of furnace when we consider present industrial conditions.

Another item of engineering and commercial interest is the great possibilities indicated for the super-refining of all kinds of steel, especially the higher grades.

One of the most interesting electrical equipments was that for an electric iron smelting and finishing plant to be installed in Brazil. Owing to the scarcity of suitable fuel and the comparatively low cost of electric power electricity will be used for furnishing power and also for smelting and refining the steel. That is, the iron ore

Motor and Control Equipment for An Oil Well.

will be reduced in electric smelting furnaces, the pig iron produced by these furnaces will be converted into steel in electric steel furnaces, and this steel will be rolled into structural and other shape by electrically driven rolling mills.

A number of new applications of existing types of heating units were made. All of these were for the heating of industrial ovens and can be divided into two general classes, the first covering low-temperature work up to 900 deg. F., and the second high-temperature work from 1000 to 1800 deg. F.

In the high-temperature field electric heating was applied to the baking of vitreous or porcelain enamel which requires a heat of about 1600 deg. F.

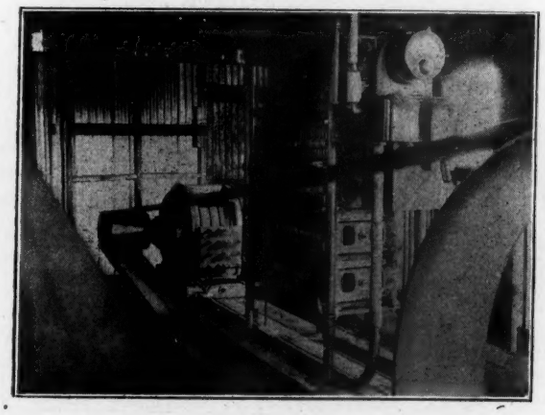
A new type of light-weight arc-welding resistor was developed for operation on electric railway trolley circuits. The resistor is primarily intended for rail-bond welding and track repairs on electric railway systems where it is necessary to move the welder by hand. This is particularly true of interurban roads and some sections of street railways where the line happens to lie through sections away from the road.

Transformers Constructed for Use on 220,000-Volt Transmission System.

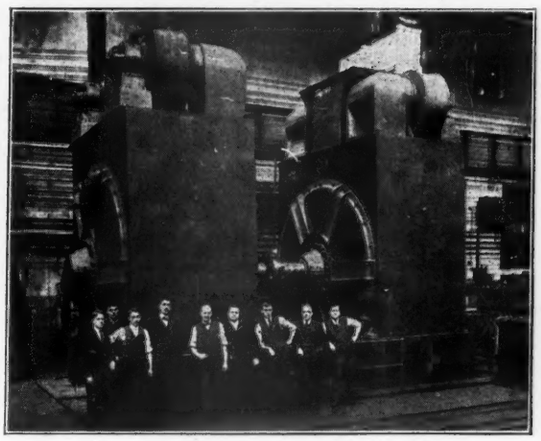
For a number of years the maximum voltage for commercial transmission remained stationary at 150,000 volts, to which point it was carried by the Big Creek system of the Southern California Edison Co., but during 1920 the potential was increased to 165,000 volts by means of transformers completed and installed, and there were under construction at the close of the year units for operation on a 220,000-volt line.

Seven 60-cycle transformers rated at 165,000 volts were completed for the Great Western Power Co. for use on a new transmission system in conjunction with an existing 100,000-volt system. These transformers are of core-type construction with concentric high and low-voltage windings and are connected in Y although designed for isolated service. They represent the maximum voltage for commercial transformers in actual service. Four transformers rated at 220,000 volts were under construction at the end of the year.

Operating reports during the year demonstrate the value and the greatly extended use of the oil conservator on large and high-voltage transformers. The utility of this feature is every day becoming more definitely established by the protection afforded from condensation of water in the transformer oil, the elimination of possible gas explosions and to the practical elimination of sludging of the oil due to its oxidation when in contact with air at fairly high temperatures.



Electric Motor for Oil-Well Pumping.



Main Propulsion Motors for a Battleship.

In order to prevent the building up of excessive resonant voltages in systems, particularly where many underground cables of high capacity are used, special shunting resistors were designed for use with power-limiting reactors.

In the production of the 165,000-volt transformers and the development of the 220,000-volt units it was necessary to design and construct bushings having physical dimensions and dielectric ratings in excess of any hitherto produced for commercial work. The construction of the first 220,000-volt transformers and oil circuit-breakers required the manufacture of the first 220,000-volt bushings intended for actual commercial service. These bushings have a maximum voltage rating of 250,000 volts at sea level. They are of the oil-filled type. The upper portion of the bushing, above the cover, consists of two sections of porcelain mechanically bolted together, and the lower portion, below the oil, consists of a single-piece porcelain. It has an average flashover voltage of about 660,000 volts dry and 445,000 volts wet, and receives a 1 min. dry test of 565,000 volts.

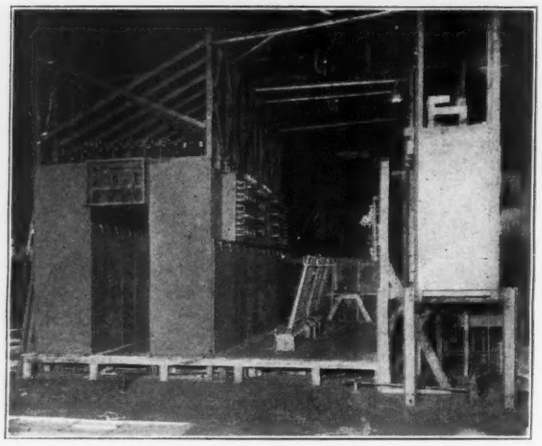
In general, it may be said that the most important developments in switchboards and switching apparatus can be summarized as follows: There was increased standardization of the apparatus and the manufacturing methods by which it was produced with a resulting interchangeability of parts; switchboards of the latest types either dead front, drawout or truck type can now be assembled to present a homogeneous appearance.

The line of high-pressure, high-interrupting-capacity oil circuit-breakers has been extended to include units of 220,000 volts. Circuit-breakers for use up to 73,000 volts are arranged for mounting on the floor or on a framework high enough to allow the lowering and removing of the oil tanks with the contacts open. For voltages of 95,000 and above they are either installed on the floor or on steel girders which rest on concrete foundation pedestals.

A new oil circuit-breaker for outdoor pole mounting possesses several characteristics never

before included in equipment for this service. It is built in 15,000-volt, 400-ampere capacity only and is manually operated. It is of standard unit construction and the blades, contacts and tanks are interchangeable with those of the standard unit-type oil circuit-breakers of the same capacity. The bushings are of the same type as those used in large outdoor oil circuit-breakers of high interrupting capacity, and the connections to the line are made at the upper extremity of the bushings and not inside the cover as in the usual construction.

A new type of solenoid control relay was developed which possesses features that will make it feasible readily to replace the present types of



Control Station for Electrically Driven Ship.

solenoid control relay. It can be made either instantaneous opening or hesitating in action, and has the same general appearance in either type.

Progress in Electrical Illumination.

Few marked innovations in incandescent electric lamps appeared during the year, but there was a great deal of development work done, the results of which were largely evident as refinements in quality rather than as striking changes in design. Material progress was achieved in the standardization of voltages, and information available indicates that 79% of all incandescent lamps sold in 1920 will be used on either 110, 115 or 120 volts as compared with 45% of lamps used on those voltages in 1913.

With the advent of the foot-candle meter illumination measurement at once progressed from an expert operation to one which can be made with reasonable accuracy by a layman. Industrialists as well as merchants and others are now beginning to prescribe their own lighting in terms of foot-candles. About 4000 of these instruments have been sold in the last two years and several hundred a month are now being put out. The general knowledge of illumination quantity on the part of light users is certain to result in a betterment of lighting practice.

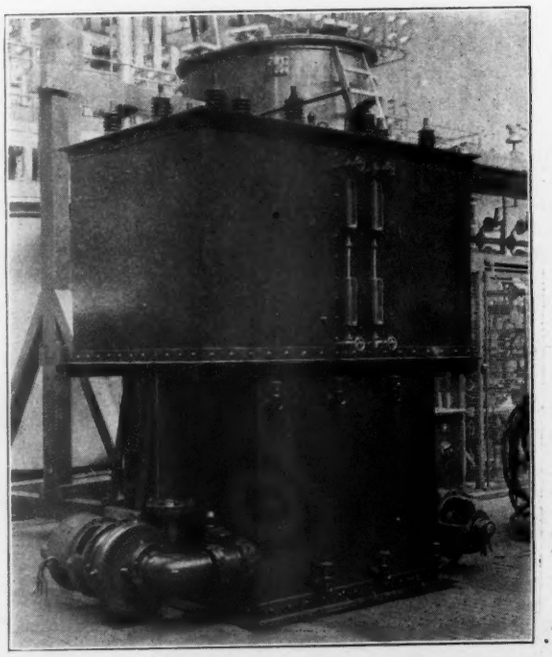
The year 1920 stands out as one in which the advantage of high-level illumination for industrial plants has received remarkable support as a means of increasing the rate and economy of production. Responding to this interest the lamp manufacturers developed the demonstration method of illustrating modern practice and its effectiveness. Special demonstration rooms were constructed in Cleveland, Harrison, Chicago and at Association Island. Such a demonstration at the Pasadena convention of the National Electric Light Association resulted in the undertaking of a nation-wide campaign of education. More or less permanent demonstrations have been erected in Baltimore and New York, while others are under way in Boston, Philadelphia, San Francisco, Los Angeles, Cincinnati and other large cities.

The Associations of Fixture Manufacturers and Lighting Fixture Dealers held what was known as a fixture market in Detroit during the year. At this meeting new designs were displayed and developmental work discussed. A meeting is planned for Buffalo during the present year. This will be on a more elaborate scale than heretofore, and a "better lighting week" on which all the electric interests of the city will co-operate is contemplated. Talks will be given to local organizations and educational demonstrations are a part of the program.

Two important street lighting systems were completed and placed in operation during the year, one of these being in Los Angeles, Cal., where luminous arc lamps are used, the other being in Saratoga Springs, N. Y., where incandescent lamps are used.

The system on Broadway, Los Angeles, was lighted Jan. 17, 1920, there being 134 two-light ornamental standards utilizing 6.6-ampere luminous arc lamps.

The Broadway system at Saratoga Springs, N. Y., was placed in service June 19, 1920, and represents the highest intensity of illumination so far used for incandescent street lighting. Each of the ornamental standards is equipped with two duoflux units, each of which contains one 1000-cp. and one 250-cp. series Mazda lamp. The larger lamp in each globe is extinguished at midnight at which time the smaller one is lighted. This arrangement permits the use of reduced illumination of a uniform intensity after midnight without a duplication of lighting circuits.



Liquid Rheostat for Marine Service.

Ultimate Boiler Capacity Limited by Fuel Conditions*

Size and Characteristics of Fuel Influence Rates of Ignition and Combustion—Air Supply Important—Fusing Temperature of Ash Limits Possible Rates of Combustion on Grates and in Fuel Bed

By JOSEPH HARRINGTON

Vice-President and Engineer, James A. Brady Foundry Co., Chicago.

This discussion takes up a very practical phase of boiler-plant operation which is beginning to be felt and appreciated by users of the modern high capacity mechanical stoker. It is generally understood that apart from the friction loss difficulties in getting the gases through a boiler setting there is no practical limitation to the rate at which a properly designed boiler can be forced. Passing the responsibility back to the stoker, certain fundamentals are discovered which definitely limit the amount of heat that can be liberated on the stoker grate surface. Any discussion of fuel characteristics is inextricably bound up with the parallel discussion of stoker characteristics, and, in reality, this article and the concluding one should properly be considered as one discussion. In this one, however, more weight will be given to the fuel part, and in the next one more weight to the stoker part.

Consideration Limited to Characteristics of Solid Fuels.

Only solid fuels or, to be more specific, coal in the size and condition generally understood as stoker fuel will be considered. This varies widely although, as a rule, bituminous coals suitable for stoker use are considered as that part of the mine product which will pass through a 2-in. round hole. These screenings, or nut and slack, carry a varying percentage of nut coal assumed generally to be from 30 to 40% of the total. The finer particles of this coal may be very fine—amounting when dry to actual dust, and obviously of such a nature as to be easily carried away in a current of air or fall through a small opening in the grate surface. These fines also serve to make a dense fuel bed, filling the voids between the larger pieces and packing somewhat in proportion to their fineness and degree of wetness. The resistance offered by such a fuel bed therefore becomes fairly large, especially when it is compacted or condensed by any work done upon it by the stoker in forcing it onto or distributing it over the grate surface. With slack coal carrying an extreme of moisture and fines this packing may be very pronounced, and it may occur in spots or streaks to such an extent that these spots or streaks will not burn in passing through the fire, but will emerge at the discharge end of the stoker either as coked masses or clinkery aggregations. We therefore meet a practical limit to capacity whenever natural draft is in use at an early stage in the discussion. Unless unusual conditions of chimney and breeching construction obtain the effective draft in a boiler furnace seldom exceeds 0.5 in. of water, and to the best of the writer's knowledge it never exceeds 0.75 in.

It is axiomatic that to secure combustion at all air must be forced through the burning fuel bed so as to provide the necessary oxygen, and that the rate of combustion is in proportion to the amount of air supplied. When the draft intensity is insufficient to cause air to flow freely through the fuel bed the limit has been reached. In practice with middle western bituminous coals this is actually the case when about 40 to 45 lbs. of coal per sq. ft. per hr. is burned. With the finer and denser grades of slack 40 lbs. would probably be the maximum, whereas if coal is used having a preponderance of nut greater porosity and less resistance is secured and bursts of speed up to 50 lbs. per sq. ft. can be secured. These are, of course, somewhat extreme cases and the average plant with a 150-ft. stack seldom has over 30 lbs. per sq. ft. completely consumed.

Use of Forced Draft Results in Increased Rate of Combustion.

Increased ratings, however, in such a case can be readily secured by the application of forced draft to the underside of the fuel bed. When this is properly applied the forced-draft fan overcomes the fuel bed resistance, leaving to the stack only the work of overcoming the boiler and breeching resistance. Large increases can thus be secured, especially if, when the higher rate of combustion is developed, less air per pound of coal can be used.

It is practically useless to extend this discussion to anthracite coal or coke breeze under natural draft conditions since the resistance offered by these fuels is such that forced blast is always required.

The United States Bureau of Mines has definitely determined that with a bed of incandescent carbon only 7 lbs. of air can be forced through the fuel bed for each pound of carbon burned. In other words, under such a condition, if more air pressure were applied it would merely result in burning more carbon, and so far as these experiments were concerned it is believed there was no limit set to the amount of carbon that could thus be burned. The application of this to power-plant practice is interesting because,

*Third of a series of articles by Mr. Harrington, assisted by W. A. Nelson, advisory engineer of the James A. Brady Foundry Co., dealing with the present fuel situation from a combustion standpoint. Features of stoker construction and operation as related to ultimate boiler capacity will be taken up in the next and final article.

as is well known, 7 lbs. of air per pound of carbon is not sufficient to satisfy the chemical requirements for complete oxidation. It is therefore obviously necessary that the carbon undergoing combustion must secure from some other source the balance of the air required for its oxidation. Where this air comes from is a most interesting and important consideration in this discussion. To answer this question without prolonging the argument, it may be said that the air enters through fissures or channels in the fuel bed, through thin spots or bare spots in the fire, or in some similar manner without coming into contact with the glowing fuel. Now, if it is not wanted to have too much of this additional air blown into the furnace, it is necessary to be very careful how large or extensive these fissures are, and it is necessary to keep them under careful control or lowered efficiency will result. In the ideal fuel bed there would be just enough of these fissures to supply the requisite additional air, and as the fuel bed changed in its progress from ignition to ash the volume and pressure of air would be exactly suited to the condition of the fuel. Uniformity in the character of the fuel bed is an essential. Anyone who has conducted careful high-efficiency tests knows without being told how quickly the efficiency will drop when a hole appears in the fuel bed. It seems as though all of the air available tried to get through that one hole and, as a matter of fact, a good deal of it does go through the holes.

High Combustion Rates Obtained With Locomotive Boiler.

Tests on a locomotive conducted by Prof. Schmidt at The University of Illinois demonstrated the ability to burn up to 250 lbs. of Illinois coal per square foot of grate surface, although it is believed in this case some 40 lbs. of coal was blown out of the stack due to the very high velocity of the gases passing through the fuel. To secure any such phenomenal rate of combustion it is obviously necessary to have a heavy fuel bed kept perfectly even and supplied with a coal, each particle of which is heavy enough to stay in place in the face of the terrific gale blowing through the furnace; and, while such rates of combustion are not at this stage usable, they served most interestingly to develop the possibilities in this direction. I can see no good reason why, if it should eventually become necessary, mechanical stokers cannot be designed that will feed and retain bituminous coal at approximately similar combustion rates. Even as matters stand today, it is believed to be entirely feasible to develop efficiently combustion rates with bituminous coals up to 100 lbs. per sq. ft. per hr.

In the previous reference to Prof. Schmidt's experiments, it was mentioned that the coal must have sufficient size to "stay put". This introduces another practical limitation to the amount of coal that can be burned under forced-blast conditions and is particularly applicable in anthracite and coke-breeze fires. These fuels have no coking tendency, and lie like loose sand on the grate surface. They are, as a rule, fine and pack fairly tight so that air pressures two or three times the normal natural draft pressures obtained are required. These fuels are most suitably burned in the quiet state on a stoker which permits of an undisturbed fuel bed throughout the entire combustion period. Oviously, in this type of stoker where progressive combustion features the performance, there is a gradual change in the characteristics of the fire from beginning to end, each change marking a decrease in the amount of combustible and in the resistance of the fire to the passage of air. It is entirely possible to blow these fires so hard that particles of the fuel will be lifted bodily from the fuel bed and carried up into the furnace. They are then usually caught in the furnace gases and carried on towards the boiler where they are deposited in the first quiet spot they encounter. We have, in this characteristic, a definite limitation to the amount of such fuels that can be burned.

This tendency to blow off of the grate also markes certain lignites which have a woody ash that is light and fluffy and which floats away easily in the furnace gases. It is entirely possible to blow lignite so hard that sparks will be carried clear through the boiler. Obviously, when this occurs capacity limits are approached.

Different Air Pressures Required as Fuel Moves Through Furnaces.

It is not feasible to state at just what air pressures these phenomena occur because such fuels, owing to the marked difference in the fuel bed, must be burned on stokers having zones or compartments wherein the air pressures are very markedly different. As the fuel bed tapers off towards the discharge end pressures may be reduced to one-tenth of what they were at the extreme front, intermediate zones having pressures somewhere in between. Generally speaking, however, maximum air pressures for such fuels are seldom greater than 2.5 ins., and terminal pressures may be as low as 0.25 in.

In speaking of high combustion rates high furnace temperatures are almost necessarily implied. When such combustion rates produce temperatures which are greater than the melting temperature of the ash a phenomenon results which imposes a definite limit in many cases. When a fuel bed in this condition is agitated or disturbed these sticky particles of melted ash are brought into contact with one another and an aggregation is formed which may assume serious proportions. Even when the fuel bed is not disturbed many particles of ash will melt and inclose a piece of carbon in such a manner that it cannot further be oxidized. With certain kinds of high-ash coals this is very noticeable, and it is even possible to develop such temperatures at the surface of a fuel bed that the ash will be fused as it lies in the fire and produce a blanket clinker extending over the entire grate surface. This is particularly true of Iowa coals and washer refuse. These fuels carry from 25 to 50% of ash and must be burned at rates of not much in excess of 25 lbs. per sq. ft. per hr. or the above-indicated result will occur.

As a concluding comment a brief reference will be made to those types of stokers having a traveling grate surface. Herein the rate of ignition becomes an important if not controlling factor in the amount of coal that can be burned.

Obviously, ignition must proceed as fast as the fuel is introduced, and if the ignition must proceed as fast as the fuel is introduced, and if the ignition rate is limited, then the amount of coal that can be burned is limited. Ignition is affected primarily by the design of the furnace, in which is included the length and position of the ignition arch. It is, however, largely affected by the fuel itself. There may be two coals of identical analysis, one being large, lumpy coal, and the other uniformly fine slack. The large lumps exposing less surface per unit of volume and admitting freely the cold incoming air ignite with great difficulty, and very low rates of grate travel must be used. The characteristic way to cure a low-capacity case like this is to provide enough fine coal to fill the voids between the lumps. Users of chain and traveling-grate stokers will recognize this situation without further discussion. It is a very practical limit to maximum capacities.

The amount of volatile combustible in the fuel is another item affecting combustion rates. Inasmuch as the volatiles are ignitable at a much lower temperature than the fixed carbon, and inasmuch as they are evolved at relatively low temperature, they have a definite influence on the ignition rate. Generally speaking, therefore, the higher the volatile combustible in a coal the more readily will it ignite and the more rapidly and completely will it burn. It is quite characteristic of some of the western coals that they give off flame to the very last, there being little or no lingering carbon. These coals can be consumed with great rapidity on account of this early and rapid elimination of the volatile. As has already been indicated, the concluding article on the limitation to ultimate boiler capacities due to the stoker will virtually be a continuation of the foregoing.

HYDROELECTRIC DEVELOPMENT IN CANADA.

Manitoba Credited With One-Sixth of 16,000,000 Hp. Available—Power Commission Extending Its Lines to Nearby Cities and Farms.

A recent estimate of the waterways of Canada indicates that they are capable of developing 16,000,000 hp., 16.66% of which is credited to the Province of Manitoba. This natural resource is being rapidly utilized for electrical purposes. The city of Winnipeg owns its own hydroelectric plant, valued at $7,557,492, and improvements and additions are continually being added. Electric power for manufacturing purposes is furnished as low as $0.005 per kw., and the rate for lighting service is $0.035. The total revenue for 1919 exceeded $1,250,000 and amounted to $1,097,196 in 1918. The surplus earnings for 1919 amounted to $150,000, which exceeded the 1918 earnings by $50,000.

The surplus is at present being expended on additional plants, which within two years will give the city a civic-owned plant of 100,000 hp. For a number of years after assuming ownership by the city the plant was operated at a loss. The saving to citizens in domestic lighting bills since 1911 is estimated at $4,000,000. Out of the yearly revenue deductions are made for depreciation and sinking fund to cover the city's liabilities on the power plant within 30 years.

Under the direction of the Manitoba Power Commission lines are being extended to nearby cities and farms along the way and it is planned to spend about $600,000 on this work during the coming year. Fourteen years ago the rate for light in Winnipeg was $0.20 per kw., which was reduced in 1911 under private ownership to $0.075, and in 1912 under civic ownership to $0.035, where it has since remained. Residence and commercial users are also allowed a discount of 10 to 20%. The Winnipeg Electric Railway Co. also operates an electric plant for commercial power and lighting purposes. The plant consists of both hydro and steam stations and is of 47,000-hp. capacity.

DATA SHOW EXTENT OF TELEGRAPH INDUSTRY.

According to the United States Bureau of the Census, there are 21 telegraph companies operating in this country with a total pole line of 241,012 miles and 1,888,793 miles of single wire. More than 155,000,000 messages are transmitted a year. For the convenience of customers 28,865 offices are scattered over the country. A total of 39,600 employes receive salaries amounting to nearly $40,000,000 annually.

MARYLAND ELECTRICIANS REQUIRED TO GIVE BOND.

In accordance with new regulations adopted by the Maryland State Board of Electrical Examiners and Supervisors, effective Jan. 1, all master electricians in the state who install electrical work of any kind must give a bond of $1000. This is to insure absolute responsibility for defective wiring. Under the new provision any person who discovers within a year after the completion of an installation that such wiring in house or place of business, or the like, was defective, can appeal to the board for damages.

Increase in Use of Electric Service

Donald McDonald, vice-president and general manager of the Louisville Gas & Electric Co., Louisville, Ky., in a recent interview said:

"There is a bright side to the public utility situation created by the war. Users of power have had their attention called to the certainty and reliability of central-station service. With coal at famine prices and difficult to get even at these prices, power users have turned more and more to electric service; the result has been an enormous increase in the output of electricity for power. Even in the field of domestic lighting people have found that plenty of light in their homes means a great deal in the way of comfort and comparatively little in the way of cost. These conditions will remain after the causes which brought them about have passed away. Cost of operation is slowly, but surely, coming down, while the people who have become acquainted with the luxury and convenience of electricity will continue to use it much more generously than they did in past years."

Core-Baking Ovens Heated With Electric Energy

Better Product Results From Accurate Control of Temperature and Ventilation—Tests Determine Proper Heat and Time Required for Given Product — Sanitary Conditions and Production Improved

By J. L. JONES

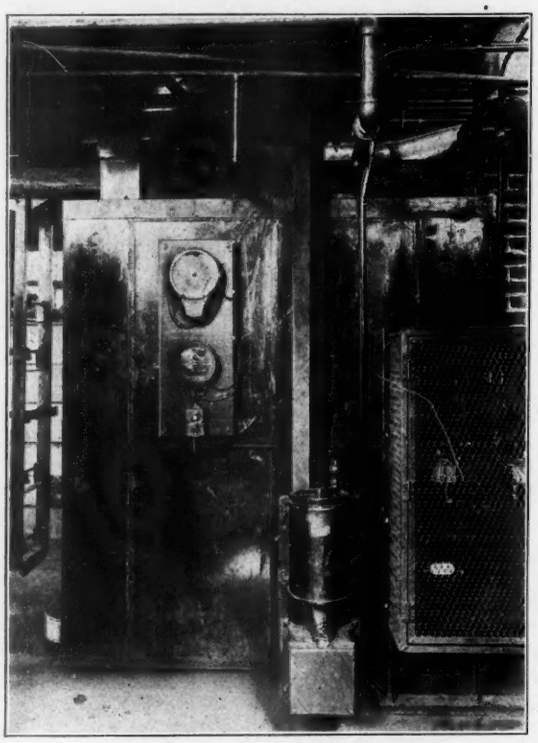
Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

The core department of most foundries has received too little attention in the past. This is especially true of the ovens used for baking the cores. The average oven that is fired by gas, oil, coal or coke has neither insulation nor temperature control. Hence, it is wasteful of fuel and considerable losses are incurred from overbaked or underbaked cores and from the inability to speed up production without endangering the quality of the product. It is not intended to discuss in detail either the various methods of electrically heating core ovens or of automatically controlling them, but it will be of interest to give a brief description of a new thermostat that is quite reliable and comparatively inexpensive. The control element consists of a strip of porous refractory material impregnated with a material that is non-conducting up to a given temperature and conducting above that temperature. The porous strip is supported by silver terminals and connected with a suitable relay, motor-driven switch and small transformer, the last-named three pieces of apparatus being assembled in one self-contained unit. The impregnating materials will not only regulate at the temperature required for core-oven work, but are capable of controlling any temperature from 150 to 1450 deg. F. with possibilities above and below these points.

Core Baking in Electrically Heated Ovens.

The accompanying tests were made to determine what would be satisfactory baking conditions for the electric core oven, and to ascertain some of the advantages of this general type of oven over fuel-heated ovens. It was not intended to deal specifically with any particular type of oven, but to investigate some of the advantages of electric heat in an oven where ventilation is carefully regulated, the temperature accurately controlled and the heaters so placed as to give a uniform temperature in all parts of the oven.

The oven used was of a draw-shelf commercial type. It was 5 ft. 8 ins. wide, 6 ft. 8 ins. deep and 7 ft. 6 ins. high and was of sheet-steel construction with walls about 4 ins. thick. The oven was fairly well insulated except on the bottoms where the concrete floor allowed the escape of considerable heat. It was equipped with a fan driven by a variable-speed motor and so arranged that the air could be exhausted or recirculated, or a portion could be exhausted and the rest recirculated. Accurate thermostatic control was provided. The accompanying illustrations show views of the oven, its control equipment and a chart of a representative day's run. As it was desired to ascertain the conditions under which cores of the best quality could be produced a number of runs were made on each of the three mixtures tested, varying the temperature and time of baking. Test cores of two kinds were used to judge thoroughness of the baking. Cores for tensile-strength tests were made, using the regulation brass molds designed for making specimens for cement testing, and compression specimens were made in 2-in. cubes. A compression and a tensile-test piece was placed on the top, middle and bottom shelf with each lot of cores.



Side View of Core Oven, Showing Regulating and Control Equipment.

Prior to making the tests a number of runs were made to determine what would be a satisfactory ventilation of the oven. It was run at a constant temperature of 400 deg. F. and loaded with weighed charges of production cores, test pieces being placed on the top, middle and bottom shelves. The rate of change of the air in the oven was controlled by the dampers and the speed of the motor, the air pressure being regis-

tered with pitot tubes. The rate of change of air was obtained by calculation from the volume of the oven, pressure and temperature of the air exhausted and recirculated. Recirculating the

Front View of Core Oven, Showing Tray and Cores Baked on It.

air 30 times per hour was the rate decided upon and used in the tests made.

The results obtained on the comparative tests made show that the electrically heated oven produces cores having from 50 to 200% more strength than the fuel-fired ovens. In baking large cores containing oil it is customary to heat them at a low temperature at first to allow the moisture to escape before the oil hardens. The first tests on the No. 3 core mixture showed, however, that this is unnecessary on small cores.

TABLE SHOWING PERCENTAGE OF VARIOUS INGREDIENTS IN CORE MATERIALS USED FOR OVEN TESTING.

	Molding machine work.	Heavy bench work.	Splicer cores only.
Mixture	1	2	3
Silica sand	63.25	16.03	97.30
Molding sand	21.35	.....	.....
Sand-blast dust	11.88	19.60	.....
Old core sand	.....	64.14	.....
Oil	1.78	.....	2.03
Dextrin	1.04	0.23	0.67

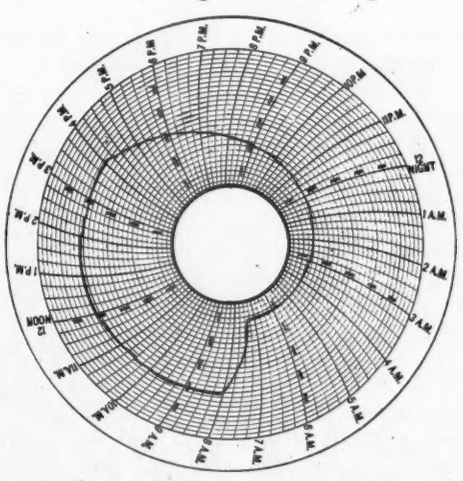
The excessive moisture (26.70%) which was found on run No. 2 for the core sand did not crack the cores or injure them in any way. Excessive moisture is undesirable, however, as energy is wasted in expelling it.

An examination of the results obtained indicates that baking at 450 deg. F. for somewhat less than an hour gives the best results. The dextrine binder seems to be weakened by prolonged baking at temperatures above 400 deg. F., however, over baking 50% or more does little harm. One lot of oil cores baked over night because of neglect to turn off the current were found to be of good quality. When forcing an oven at a high temperature an alarm clock is useful to indicate when the cores should be removed to prevent overbaking and waste of heat. It was found that the weight of the cast-iron core plates were almost equal to the weight of the cores. It is desirable to reduce the weight of the core plates to the minimum consistent with stiffness. However, the current loss due to heating these plates is only about 20% of the radiation loss of the oven. The oil used in the test was a compound oil containing mineral oil. Stronger cores would have been obtained with pure linseed oil.

TABLE SHOWING STRENGTH OF CORES MADE UNDER VARIOUS CONDITIONS IN ELECTRICALLY HEATED OVEN.

Mixture.	Temperature deg. F. Initial.	Final.	Time in hours.	Crushing load in lbs.	Tensile strength in lbs.	Power used in kw-hrs.
1	300	300	3.00	253	21	40
1	300	350	2.50	500	50	30
1	300	400	1.50	1712	192	30
1	300	450	1.50	1739	187	40
1	300	500	1.50	1244	166	50
1	450	450	0.75	1965	121	20
1	500	500	1.00	1516	142	20
2	450	450	1.00	1171	87	20
2	350	350	1.50	776	46	20
2	450	450	1.25	1550	142	30
2	300	300	1.50	675	66	20
2	350	350	2.00	802	95	40
2	400	400	1.00	906	88	20
2	400	400	1.50	1206	105	20
3	300	300	1:00	815	97	20
3	400	400	1:00	1856	188	30
3	400	400	1:50	2209	194	40
3	400	400	2:00	3854	342	50
3	350	350	1:00	754	66	20
3	350	350	1:50	1313	118	30
3	350	350	22:00	2690	180	50

Where core ovens are fired with gas, oil, coal or coke large volumes of carbon dioxide gas are produced, even where combustion is perfect. This gas, while not poisonous in itself, vitiates the air of the core room, making it an unhealthful place in which to work. Combustion in fuel-fired ovens, however, is never perfect, and instead of the waste gases consisting of carbon



Recording-Meter Chart, Showing Oven Temperatures for a Typical Day.

dioxide they generally contain large amounts of the highly poisonous carbon monoxide and other compounds irritating and injurious to the eyes and nose. With imperfect combustion soot is deposited on the walls of the ovens and on the cores themselves. In many foundries the core-room force consists of young girls. This class

of labor is especially susceptible to fumes and, hence, electrically heated core ovens are not only desirable in such situations but absolutely necessary if the labor is to be kept efficient.

It has been found as a result of the tests conducted that a practically uniform temperature can be obtained in all parts of the oven. The temperature can be held to within 5 deg. F. plus or minus of any desired temperature. The only gases given off by the electric core oven come from the core compounds used, and these gases are not excessive in amount or dangerous in character. Small oil, dextrine or oil and dextrine cores can be satisfactorily baked in less than an hour at 450 deg. F. The cores when baked in the electric oven are from 50 to 200% stronger than when baked in the fuel-fired ovens. A greater input of heat units is possible in the electric core oven without injury to the cores than is possible in fuel-fired core ovens. While no attempt was made to obtain a very accurate reading of the power consumed in making the tests, it is estimated, however, that about 12 lbs. of green cores were baked for each kilowatt-hour consumed.

TABLE SHOWING STRENGTH OF CORES MADE UNDER VARIOUS CONDITIONS IN GAS AND OIL-FIRED OVENS.

Mixture.	Temperature deg. F. Initial.	Final.	Time in hours.	Crushing load in lbs.	Tensile strength in lbs.
1	....	....	2:00	467	62
1	....	....	0:42	832	140
1	....	....	2:50	1519	102
2	....	....	2:00	776	65
2	....	....	1:00	633	57
2	....	....	2:00	779	78
3	....	....	2:00	677	87
3	....	....	3:00	1167	110
3	....	....	3:00	1334	101

PULVERIZED COAL AN EFFECTIVE MEANS OF FUEL ECONOMY.

Fuels Not Available for Other Uses May Be Burned Effectively in Powdered Form—Vast Resources in Low-Grade Fuels.

Necessity for conservation of coal resources and development of substitute fuels makes the increasing use of pulverized coal one of much economic importance, it is pointed out by the National Bank of Commerce in New York, in the January number of its magazine, *Commerce Monthly*. In contending that the use of pulverized coal will effect savings of 20% in heating efficiency the following statements are made:

"The fundamental economic advantage in burning pulverized coal lies in the complete stage to which combustion is carried in the furnace. The contact surface between coal and air is greatly increased by splitting the coal into numerous particles of small size. The second advantage in the pulverization of solid fuel is the fact that it floats in the air, spreads and is carried off by even small air currents. This makes the intimate mixture of coal and air very easy. It simplifies the construction of burners and guarantees economical combustion. The finer the coal powder the more nearly ideal conditions for complete combustion are approached.

"Where proper apparatus and methods are in use, however, other more tangible economies are effected by the use of powdered fuel. The labor cost of firing is materially lowered and losses during short periods when steam pressure is not required are reduced to a minimum. No air is allowed to pass through the furnace when firing operations stop, so that the radiant heat of the furnace is absorbed by the boiler, avoiding the losses which occur with grates through the constant burning up of fuel and incomplete combustion of the gases generated from banked fires. The time necessary to get up steam is reduced by half when pulverized coal is substituted for the same fuel in lump form.

"Until very recently the impression has prevailed that only certain grades of bituminous coal were suitable for powdering. All the most recent developments in the use of powdered coal as a fuel for steam generating plants have been made with anthracite culm, at one time definitely abandoned as a fuel suitable for powdering. High volatile soft coal gives best results, but mixtures of such a grade of coal with anthracite culm have proved entirely satisfactory and pulverization may be applied to any solid fuel, peat, lignite or bituminous coals of any grade, as well as anthracite and coke.

"Pulverized coal has obtained growing recognition as a most satisfactory fuel for reverberatory furnaces by reason of the loss and nuisances arising from flue dust in blast furnace smelting, as well as the better fuel ratio and tonnage obtained with the new type of fuel. Although the practice dates back only to the last 15 years it is now estimated that a saving of 100,000 tons of coal per 1,000,000 tons of charge smelted is made annually in the United States. Pulverized coal in the mass is not explosive nor highly combustible.

"For a time fuel oil seemed destined to replace coal in many industrial uses, and it has done so to a considerable extent. But the great increase in the output of fuel oil in recent years has been through the discovery of new sources of supply. Many of the early discovered fields have begun to exhibit a decided decrease in production due to the exhaustion of the available supply, and the increased cost of fuel oil in the districts supplied from these fields has in some cases made it necessary for industrial consumer to turn again to coal.

"The economic importance of conserving the present workable supplies of high-grade coal and of making available the vast and almost untouched reserves of low-grade fuel, which are known to exist near the surface in many parts of the globe, make the progress in the use of powdered or pulverized coal during the past decade of special significance.

"During the calendar year 1919 it is estimated that between 10,000,000 and 12,000,000 tons of coal were pulverized for industrial consumption. Of this amount 6,000,000 tons were consumed in the making of portland cement; 2,000,000 tons were used in the iron and steel industry; copper refining consumed 1,500,000 tons, while at least 250,000 tons were used in power plants. The remaining consumption of pulverized fuel was divided among a large variety of industrial uses."

Suspension Type of Transmission Line Insulators

Eleventh of a Series* of Articles Giving a Review of the Electric Power Situation—Grading Suspension Insulators—Static Shields and Arcing Horns—Design and Construction of Insulator Units

By ALFRED STILL

The suspension type of insulator was first used when line pressures of 100,000 volts were introduced. Since 1907 it has superseded the pin type of insulator for pressures above 60,000 volts and even less. With the suspension type of insulator the conductor is hung below the point of support (which is usually grounded) at the end of a string of insulator units connected to one another by metal links. The potential difference which will cause a flashover or breakdown on such a series of insulators will not be in direct proportion to the number of insulators in the string. This is due to the unequal distribution of the potential differences, which is again a question of relative capacities. The design of the individual units may appear to be good, and yet a string of such insulators, if they are not specially designed to fulfill certain requirements, may give surprisingly unsatisfactory results. A factor of importance is the ratio of the mutual capacity to the capacity to ground, which determines the potential distribution.

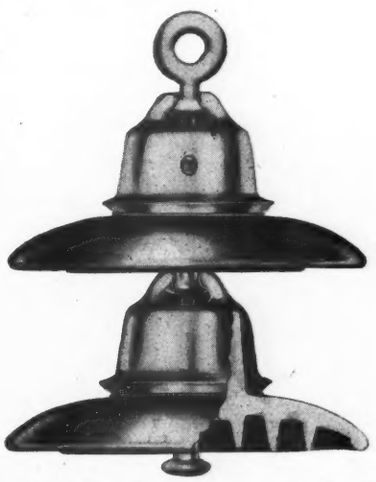
The distribution of the potential drop on a string of suspension insulators is easily calculated if certain assumptions are made with a view to simplifying the work. If symbols are used to denote the various voltages and currents, the formulas become somewhat complicated in appearance although actually simple in application. A clear explanation of the voltage distribution on the string of suspension units has been given by F. W. Peek, Jr.

The fact that the ratio of the mutual capacity to the capacity between the suspension link and ground is an important factor in determining the distribution of potential over the insulator string suggests the importance not only of the shape and surface area of the metal fixtures on the individual insulators but also the length of the connecting link and the spacing between insulators.

Grading Insulators and Use of Static Shields.

In this country it is common practice to use the same size and type of disk throughout a string of suspension units, but this necessarily leads to a greater potential difference across those near to the high-tension line than across those near to the (grounded) point of suspension. In connection with tests on strings of insulators, such as those recently conducted by Profs. Harris J. Ryan and Henry H. Henline at Leland Stanford University, the expression "voltage-duty ratio" is used to indicate the ratio between the voltages across two unit insulators in a string of suspension insulators. With a string built up of 15 standard 10-in. suspension discs a voltage-duty ratio as high as seven is possible, and this means that the unit next to the high-voltage conductor is normally subjected to seven times as great a pressure as the unit next to the point of attachment on the tower crossarm. This is unsatisfactory, and a suspension type insulator built up in this manner would be undesirable on a practical transmission line.

The grading of insulators† so as to provide for a more uniform distribution of potential throughout the string has been given much more attention in Europe than in this country. In this country we have tried and are proposing to use a metal shield between the lowest unit in the string and the high-tension conductor, and this, by preventing the concentration of the dielectric flux at the point of attachment, has the effect of improving the voltage-duty ratio.



Suspension Insulators Manufactured by Ohio Brass Co.

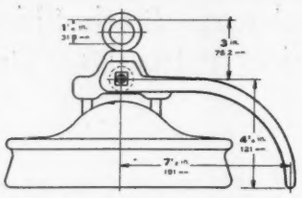
A static shield of this nature will usually take the form of a flat disk with well-rounded edges and having a diameter appreciably larger than that of the porcelain disk. An elliptical shield with its major axis in the direction of the line is also effective. Besides serving to reduce the potential difference across the units near the conductor the static shield—in common with arcing

†Alternative ethods of grading are admirably presented and discussed in Mr. Peek's recent contribution to the American Institute of Electrical Engineers. The reader interested in this matter should refer to page 623 of the Journal of the A. I. E. E., July, 1920.

*The first article of this series was published in the July 17, 1920, issue of Electrical Review, subsequent articles appearing in the Aug. 7, Aug. 21, Sept. 4, Sept. 18, Oct. 2, Oct. 16, Nov. 6, Nov. 20, Dec. 4, Dec. 18 and Jan. 8 issues.

horns and rings—also tends to prevent corona formation over the porcelain surface at the point where the metal caps or links are connected to the porcelain. On a string of ten disks, the provision of a static shield may reduce the potential drop across the first insulator unit by as much as 25 to 40%.

Although maximum voltage-duty ratio as high



Arcing Horn for Suspension Insulators—Manufactured by R. Thomas & Sons Co.

as seven has been mentioned as possible on a string of 15 units, this ratio would be about 2.5 on a string of ten units, and this could be reduced to below 1.5 by the provision of a static shield of the type above described. A still further improvement could be made by grading the units, i. e., using two or more different sizes or designs in the same string.

Number of Units in a String of Suspension Insulators.

The number of units in a string will depend upon the line voltage and the size or make of unit. Lines operating at 66,000 volts are using strings with any number of units ranging from three to eight. The higher voltage lines will naturally require more units, but owing to the unequal distribution of potential drop along the series the addition of extra units to a long string will have little effect in reducing the potential difference across the first unit. Additional units in excess of the number which appears requisite for the duty demanded of them increase the safety factor of the string because they will take their share of the voltage in the event of the breakdown of other units. On 110,000-volt lines the number of units per string ranges from five to nine. On 130,000-volt lines nine or ten units are used, but as many as 12 units in a series are used at dead-ends on tension towers.

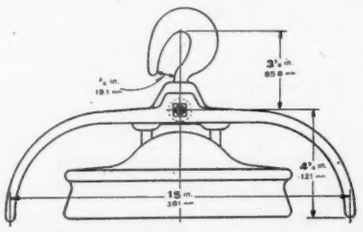
From what has been said concerning the voltage distribution over a string of suspension units it will be understood that when the mutual capacity is small relative to the ground capacity there soon comes a point beyond which it is useless to put more insulators in the string. Short strings of well-designed and properly spaced units will often be more effective and less costly than a longer series of insulators of which the single units may have excellent insulating properties, but may not have been specially designed for the particular requirements. It is sometimes possible to increase the arc-over voltage of a string of insulators by reducing the distance between consecutive units, a fact that it is difficult to understand unless the importance of the proper capacity distribution has been realized. A well-arranged string of properly designed units, not necessarily similar in shape and size, is less liable to damage by lightning and kindred phenomena than a series of insulators of high voltage-duty ratio.

It is well to bear in mind that an insulator may and does behave differently when subjected to high-frequency charges such as those induced by lightning disturbances than when the difference of potential is applied at the normal frequency of the transmission line. The distribution of potential among a number of condensers in series should be independent of frequency, but a high-tension insulator consists of many capacities in series with resistance such as the leakage paths through the body of the material and over the surfaces and the distribution of the total potential drop across a condenser and resistance in series, even if the latter may be considered non-inductive, is not the same at high as at low frequencies. This is one of the reasons why insulators that will flash over rather than puncture on tests conducted at the ordinary line frequency will sometimes fail through puncture during atmospheric electrical disturbances.

Apart from the great advantages from the point of view of insulation which are obtained by suspending the conductor from a string of insulators connected in series, this arrangement, now generally adopted for pressures above 50,000 volts, has the further advantage that the conductor is less liable to be affected by lightning disturbances, since at every point of support the wire is hung below the attachment to the supporting tower, which in almost every instance is a well-grounded steel structure. Another advantage is the comparative flexibility of the attachment, which very considerably diminishes the possibility of crystallization of the conductor material, such as is liable to occur when the wire is rigidly attached to the pin type of insulator. This effect is more noticeable with aluminum than with copper.

Design and Construction of Suspension Insulators.

A great deal of attention has recently been devoted to the improvement of the suspension type of insulator. The parts of the early designs were cemented solidly together, with the result that the differential expansion of porcelain and metal caused cracking and consequent destruction of



Thomas Arcing Horn for Use in Connection With Strain Insulators.

the porcelain after being in use for only a few years. That experts in insulator design realize the effects of expansion and other causes leading to rapid deterioration of porcelain insulators is evidenced by the experimental work that has been carried on, and the number of papers published relating to this subject during the last three or four years.

It is proposed to discuss the question of deterioration and failure of insulators in another article. Unquestionably much trouble has arisen

through unequal expansion under temperature variations of porcelain, cement and hardware in the usual type of unit in which the metal cap and link are cemented to the porcelain. When trouble was first encountered due to this cause, felt or paper gaskets were placed between the metal cap and the porcelain. In more recent designs these gaskets were removed from the finished product after the cement had set, to avoid trouble due to ionization; but various devices of the nature of elastic washers or packing between metal and porcelain are now used with a view to overcoming this trouble.

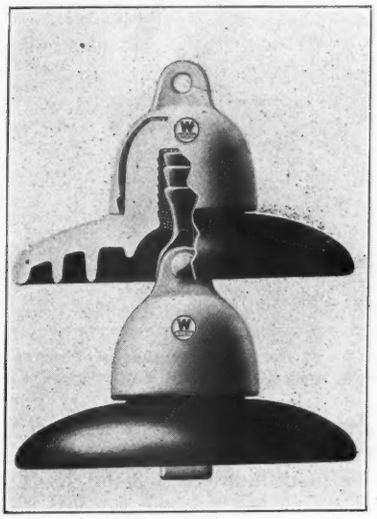
Cap and pin type suspension insulators of Westinghouse manufacture are set under steam for the purpose of accelerating the setting action of the cement and of having the setting action take place with the materials expanded. Cement which has passed the required test is sifted through a 1/16-in. mesh sieve and thoroughly mixed, giving a mortar semi-fluid in consistency. The cap is placed, clevis down, in a rack made for this purpose. The cushioning material is placed in position and enough cement poured into the cap so that when the insulator is pressed into position some of the cement flows over the edge of the cap. The cushioning material for the pin is then placed in position, cement added and the pin inserted. The pin is worked to drive off the trapped air, settle the cement and obtain the proper alignment. The assembled insulator is then picked up by the cap and transferred to the steam chamber, being placed in the inverted position on a rack. The air in the steam chamber while the insulators are being placed is kept moist by throwing water on the floor. After filling, the doors of the chamber are closed and the steam turned on.

In the Jeffery-Dewitt suspension insulator unit the troubles due to unequal expansion of the metal cap cemented to the porcelain are overcome by employing a flexible spider fastened to the porcelain by means of an alloy having sensibly the same coefficient of cubical expansion as the porcelain, thereby eliminating the temperature effects in the operation of the insulator. The makers of this insulator have no hesitation in submitting it to the following test: Immerse in boiling water for five minutes; remove and plunge immediately into iced water for five minutes; then back into the boiling water, and so on, repeating the process as often as desired.

Advantages of Thick Porcelain in Suspension Insulators.

In this, as in other modern designs of line insulator, there is seen a tendency to thicken the porcelain. Improved methods of manufacture permit of reliable porcelain being produced of a thickness much in excess of what was used in the earlier insulators.

A low flashover voltage will not always protect an insulator from puncture under abnormal conditions. It is found that the transient voltages which are frequently encountered on transmission systems have a certain time lag in regard to the flashover. Indeed, an insulator which under the usual test conditions has a dry flashover of 100,000 volts may be subjected momentarily to more than 150,000 volts without flashover, this abnormal voltage being a combination of the line voltage of normal frequency and highly damped transient impulses which may be the result of switching operations. A puncture voltage of two and one-half to three times the dry flashover voltage is therefore desirable in order to provide a reasonable factor of safety. Experimental research seems to indicate that the minimum thickness between the electrodes of a suspension-type unit should if possible be of the order of 2.25 ins.



Suspension Insulator Made by Westinghouse Electric & Manufacturing Co.

In order to fulfill this requirement the Jeffery-Dewitt Co. has produced an exceptionally rugged design of insulator of great mechanical strength capable of withstanding a pull of 9000 to 10,000 lbs.

It is obvious from what has already been said about the concentration of dielectric flux causing a dangerously high potentail gradient in the neighborhood of the points where the metal is attached to the porcelain that a large distance between electrodes (i. e., an increased thickness of porcelain), by reducing the dielectric flux density, will tend to keep the potential gradient well below the critical or disruptive value. As a matter of general interest the following figures furnished to the writer by Mr. Peaslee, and representing the results of tests made on a string of five J-D suspension units, are reproduced here. They show how the voltage is distributed between the units connected across 110,000 volts, and how the change in the capacities of the condensers in series alters this distribution when the insulators are wet. The top figures give the potential drop across the unit nearest the tower, while the bottom figures refer to the unit nearest to the high-voltage line.

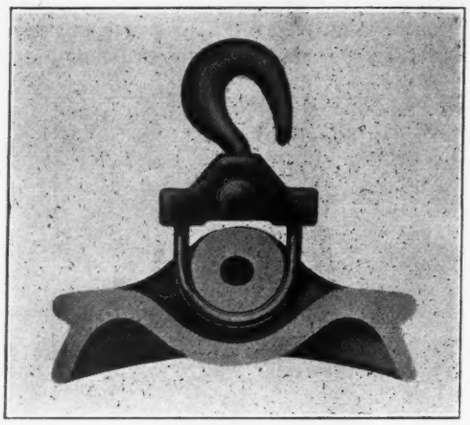
Dry test.	Wet test.
19,000	21,000
16,500	19,000
20,000	20,000
23,500	24,000
31,500	26,800

The maximum voltage-duty ratio is seen to be 1.91 under dry conditions, and only 1.41 when the porcelain is wet, the unit with the lowest voltage across it being in both cases the second from the point of attachment to the crossarm.

A design of insulator with loose-fitting parts—that is to say, in which the metal does not grip

the porcelain through the medium of a thin layer of cement—is less liable to suffer injury through unequal expansion due to temperature changes than the more common design in which cement is used.

The link type of unit constructed as shown in

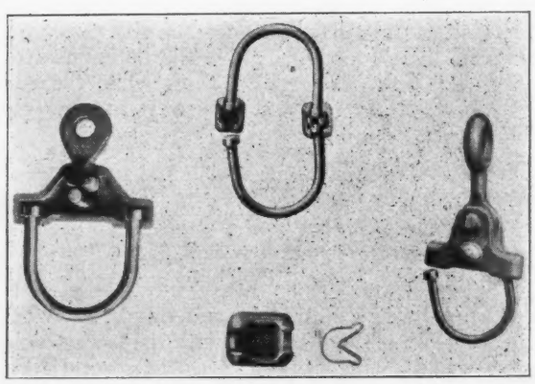


Cross-Section of Porcelain Member of Thomas Insulator, With Hook, Clevis and Soft Copper Link.

the accompanying illustrations was originated by Edward W. Hewlett more than ten years ago. It is now manufactured by the R. Thomas & Sons Co., which has devoted the last three years to the development of suitable hardware fittings which were not entirely satisfactory in the earlier designs.

The advantages claimed for this type of insulator are: (1) The porcelain is thrown in absolute compression, having no side pull nor lengthy porcelain walls in tension; (2) the entire surface of the insulator is thoroughly glazed; (3) the flexibility of parts does not cause concentrated stresses at any particular point, but produces an even distribution of the load; (4) units may be assembled and strings made up in the field as easily as at the factory; (5) the ultimate cost is greatly reduced on account of longer life of the insulator and the salvaging or the re-using of connecting parts.

The suspension type of insulator appears to be the only one suitable for use on the high-voltage lines at present in operation and for the still higher voltage lines which will be erected in the near future. Although porcelain—for reasons which will be further discussed in a following article—cannot be said to be an ideal material



Clevis and Soft Copper Link Used With Thomas Suspension Insulators.

for insulators on overhead lines, yet it seems to be the only material at present available on the higher voltages. It is therefore safe to predict that porcelain will be used for many years to come, and moreover that satisfactory insulators will shortly be available for use on 220,000-volt transmission lines. There is no denying that the insulator is a weak point in the power transmission system, but what can be done now on 110,000 and 150,000-volt lines can certainly be done with the same type of insulator on 220,000-volt lines.

It is merely necessary to see that reliable units are used and that these are suitably graded or provided with a static shield so that excessive

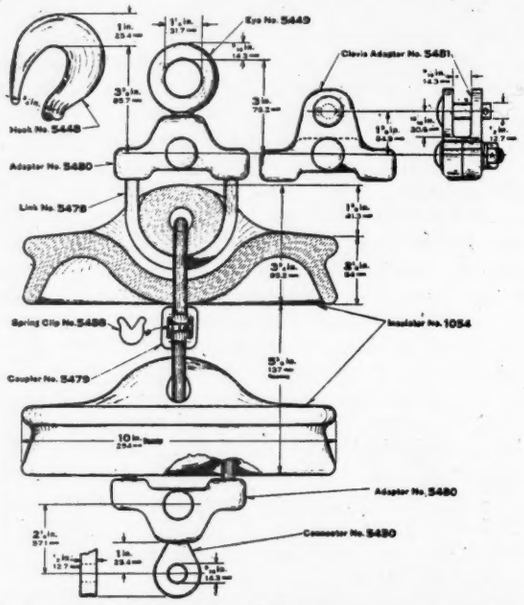


Illustration Showing Adaptability of Thomas Link-Type Suspension Insulator.

corona will not be present on the units near the high-tension conductor, and the uneven distribution of potential drop across the string of units will be largely corrected.

It is probable that there will be fewer troubles due to arc-overs caused by lightning or switching operations on the proposed higher voltage lines than on the transmission systems at present operating between 110,000 and 150,000 volts.

STRUCTURE OF BITUMINOUS COAL.

Bulletin No. 117 of the United States Bureau of Mines presents a rather full review of a study of the structure and formation of bituminous coals. Brief comment is made on the work of various investigators who have studied the structure and nature of coal from 1831 to the present time. The present article was prepared after a detailed study of coal samples gathered in Pennsylvania, Indiana, Illinois, Ohio, Oklahoma and Iowa in this country and from various localities in China, Japan, New South Wales and England.

The various samples of coal were examined under the microscope, and brief analysis is made of the many microphotographs reproduced. In all there are 160 plates showing one or more views of coal samples enlarged from 10 to 1000 times.

Use of Superheated Steam in Power-Plant Operation

Steam Consumption of Turbines and Engines Reduced by Superheat—Superheaters Installed in Boiler Setting or with Seperate Furnace—Cost of Equipment an Important Factor

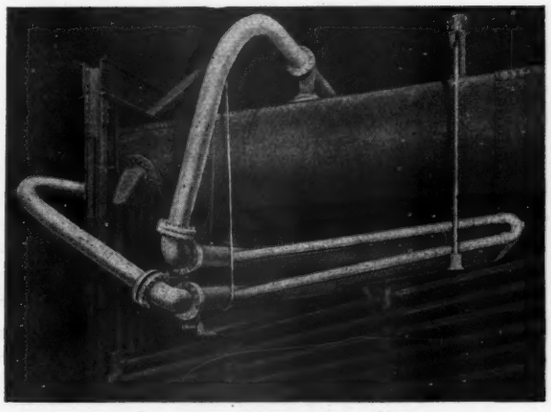
The possibilities of effecting economies in the power plant through the use of superheated steam are worthy of careful consideration in view of existing high fuel and labor costs. In this connection the fact should be recognized at the outset that the use of superheated steam is not necessarily confined to new plants especially designed for such operation, but that in many cases old plants can be successfully adapted to its use without incurring excessive expenditures. In this discussion it will be well to examine the effects of superheating, factors governing the advisability of using superheat, temperature to which the steam is to be raised, superheater construction, materials for use with superheated steam, and some details of operating practice.

By superheating is meant raising the temperature of steam immediately after its generation in the boiler to a point considerably above the saturation point without greatly increasing its pressure. When utilized in the steam engine superheated steam possesses a number of advantages. The more heat supplied per unit of volume of steam to the engine the more work can be obtained from the engine, and the increase of pressure having a practical limit this extra heat may be obtained by superheating the steam. A moderate amount of superheat produces a large increase in volume, the pressure remaining constant, and diminishes the weight of steam per stroke for a given amount of work. The diminished density of the steam employed to do the work lessens the back pressure, or, as commonly expressed, improves the vacuum. This also applies to the air and vapor which are carried with the steam and are further expanded by the increased heat, and are also contracted to a much less volume when chilled by striking the cooling surface of the condenser; thus the air pump has less work to do.

Prevention of condensation during expansion without the use of steam jackets is the most important advantage to be attached to the use of superheated steam. Steam jackets are wasteful and inefficient when applying heat to the engine. They are inefficient because contact is made only with the steam immediately adjacent to the wall of the cylinder, with probably little effect being derived by the steam in contact with the piston and in the interior of the cylinder out of reach of the radiation from the wall. They are wasteful because of the effect of heating the exhaust steam after it has done its work in the cylinder during the waning stages of expansion and throughout the exhausting stroke. This is particularly true of engines which have a pause at the end of the stroke, which pause always finds the cylinder full of steam which has completed its work in the cylinder and is ready to be exhausted. Ample evidence of the truth of this statement is found in the high ratio of water condensed in the jackets of direct-acting pumping engines to the amount of steam used in the cylinders. Use of superheated steam results in the elimination of condensed water in piping leading to the engine, and in the reduction of friction, cutting down loss of pressure in ports and passages and permitting reduction in the size of conducting pipes.

Factors Governing Advisability of Using Superheated Steam.

Decision to use or not to use superheated steam in any particular plant will depend upon a thorough study of the plant conditions, taking into account fuel cost, engine performance, capacity of plant, steam-line losses, costs to install and maintain superheaters, etc. As a general proposition the savings to be effected from the use of superheated steam vary inversely with regard to the efficiency of the prime mover when



Superheater Installed on a Water-Tube Boiler.

using superheated steam, being greatest with direct-acting pumps and smallest with steam turbines. A fair estimate of the average saving which may be effected with moderate superheat, say 100 to 125 deg. F., based on continuous operation of existing plants, is 40% for slow-running, full-stroke, throttling engines, including direct-acting pumps; 20% for simple noncondensing engines with medium piston speed, including compound direct-acting pumps; 10% for compound condensing Corliss engines; 6% for tripple-expansion engines, and 6% for turbines. Of course, higher figures than these have been obtained, but these may be taken as a fair average. An accompanying table gives a fairly accurate

range of steam consumption for prime movers, based on saturated steam and 100 deg. F. and 200 deg. F. of superheat.

Naturally the capacity of the plant has an important bearing upon the advisability of using superheated steam, inasmuch as the cost of the installation may be out of proportion to the savings to be effected. If the steam consumption is equivalent to about 250 hp. continuously, however, it would seem desirable to investigate the possibilities of superheated steam. If the plant is large the question should by all means be taken under advisement. This is particularly true where there is any apparent lack of boiler capacity, as it may develop that the use of superheated steam will eliminate the need of purchasing additional boilers. Another point worth considering in this connection is that, in the case of old boilers, the insurance companies may require that, owing to their condition, they be operated at lower pressures. Under such circumstances a loss in capacity of the boiler results. The loss may be made up by a change from saturated to superheated steam.

TABLE SHOWING RANGES IN STEAM CONSUMPTION BY PRIME MOVERS.

Type of engine.	Steam consumption, lbs. per hp-hr. Saturated steam.	Superheat 100 deg. F.	Superheat 200 deg. F.
Simple noncondensing	29- 45	20- 38	18-35
Simple noncondensing automatic.	26- 40	18- 34	16-30
Simple noncondensing corliss...	26- 35	18- 30	.....
Compound noncondensing	19- 28	15- 25	13-22
Compound condensing	12- 22	10- 20	9-17
Simple duplex steam pumps 120-300		80-160	.....
Turbines, noncondensing (kw-hr.)	28- 60	24- 54	21-48
Turbines, condensing (kw-hr.) ..	12- 42	10- 38	9-34

Steam Line Losses by Condensation and Radiation.

Condensation in long pipe lines is a problem which is faced in many plants. About 90% of the heat necessary to evaporate water is latent heat, and if condensation takes place before the steam is transformed this latent heat is liberated and the waste and losses due to condensation may be large. Under the best conditions, with properly proportioned well-covered steam pipes, we find a loss of up to 0.3 deg. F. of superheat per foot of steam pipe. It seems reasonable to assume that with the ordinary large and indifferently covered steam pipe the loss may reach as much as 1 deg. F. for every foot of pipe; consequently a pipe 100 ft. long would probably lose 100 deg. of superheat which is equivalent to 5% of moisture in the steam, if we assume that the steam is dry before leaving the boiler.

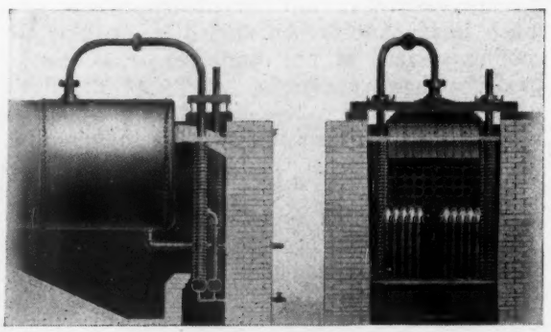
Superheat is necessary to raise the temperature of the steam to a point where it may all be transmitted to its destination without continuous loss. As superheated steam does not give up its heat as readily as saturated steam it can be transmitted with smaller total loss. Superheated steam is therefore valuable as a means of eliminating the condensation in steam pipes.

The cost of installing superheaters should be figured to include not only the cost of equipment, but also the cost of remodeling the steam lines should this be necessary. Superheated steam will, of course, cause greater expansion and contraction in the steam lines, and it may be necessary to make important changes in these lines before superheated steam can be used.

Insofar as maintenance is concerned, if the superheater is installed in the boiler it can be regarded as a part of the boiler and there is no reason why its maintenance cost should be higher than that of the boiler with respect to the comparative cost of the two installations. If pipe lines are not properly arranged they may be more expensive to maintain, but the remedy for this is proper arrangement to take care of the expansion and contraction. Once this has been secured there is no reason why piping for superheated steam should cost more than that for saturated steam.

In the United States and Canada total steam temperatures rarely exceed 600 deg. F., while in Europe this is a common temperature, and temperatures of 850 deg. F. are often reached. This does not necessarily mean that steam practice in Europe is in advance of steam practice in America and Canada. In Europe there has been a condition of excessively high fuel costs and low labor costs, whereas we have had the reverse, that is, comparatively cheap fuel and very high costs for labor and materials. This means that, insofar as we are concerned, the greatly increased cost of an installation above a total temperature of 600 deg. F. may so far offset the possible savings in fuel that the installation will not be economical.

As a general proposition it may be stated that for at least 95% of the steam plants in the United States and Canada 100 deg. F. of superheat is about right, and that only in exceptional cases should superheat exceed 125 deg. F. It should be remembered that high temperatures are apt to interfere with lubrication, and perhaps to cause warping of the valves. With the use of superheated steam difficulties of this nature are to be expected. While on this subject of the effect of superheated steam on the valves of an engine, it may be well to consider the conditions obtaining in an engine when superheated steam is used. After leaving the superheater, and while passing through the steam lines, the heat lost by radiation does not cause condensation, but instead merely causes a loss of a portion of the superheat.



Superheater on Fire-Tube Boiler.

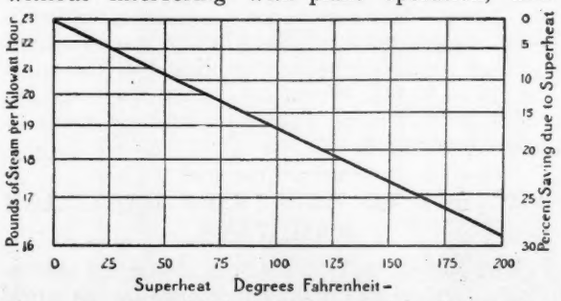
The greatest saving from superheat is obtained in the engine cylinder and results from the elimination of most, if not all, of the loss due to cylinder condensation. Saturated-steam losses occur in the cylinder, due to condensation caused by the steam coming in contact with the relatively

cool cylinder walls. The drop in pressure caused by this condensation induces a further flow of steam into the cylinder to fill the space originally occupied by the steam which has been condensed. In the average simple engine cylinder condensation varies from 20 to 40%, and as the water of condensation takes up less than 0.01 as much space as the steam we may assume that the same amount of steam will be required to replace that which has been condensed. Even with superheated steam it is not always possible to obtain dry steam at cutoff, but the important point is that most of the losses caused by cylinder condensation are eliminated. The presence of moisture in steam is apt to result in the use of large amounts of oil for lubricating purposes. With superheated steam the walls of the engine cylinder are free from water and a thin film of oil adhering to the surface will give satisfactory lubrication.

Important Points in Superheater Construction.

Superheaters are of two general types—those placed independently of the boiler, and those built into the boiler and at some point heated by the gases from the boiler furnaces. With water-tube boilers it is usual to place superheaters between the first and second passes, although this arrangement varies with the individual boiler. With fire-tube boilers the superheater is placed in the combustion chamber at the rear of the boiler.

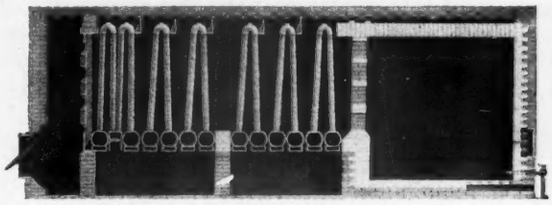
Since the absorption of the heat depends upon the average difference of temperature between the gases and the steam the required degree of superheat may be obtained from a comparatively small amount of heating surface close to the furnace, or a larger amount at a greater distance. The requirements of a successful superheater are safety of operation and minimum danger of overheating, construction permitting of free expansion, an arrangement such that it may be cut out without interfering with plant operation, and



Saving by Superheat Indicated in Test of High-Speed Triple-Expansion Engine.

provision for keeping the surfaces exposed to the hot gases free of soot. Some of the advantages of the independent superheaters are that the degree of superheat is not dependent upon boiler performance and repairs may be made without refence to the boilers. Among the disadvantages of this type of equipment are the facts that they require individual attention, require extra piping, and require additional space. Superheaters placed in the boiler setting have the advantages of lower first cost, they require no individual attention, and they take up no additional space. Such equipment has the disadvantage of being subject to boiler conditions, and must be watched during the period of cutting in boilers. In addition to this the superheat is apt to fluctuate with temperatures in the furnace.

A great deal has been written about the advantages and disadvantages of certain types of superheater construction. At the present time there



Independent Type of Superheater.

are a number of superheaters on the market which have been brought up to a high state of perfection, and there is no need here to enter into a discussion of their relative merits. The commercial superheater companies, and large manufacturers of superheaters, have competent engineers who specialized in superheater work, and the power-plant manager or superintendent contemplating a superheater installation will do well to consult with these specialists.

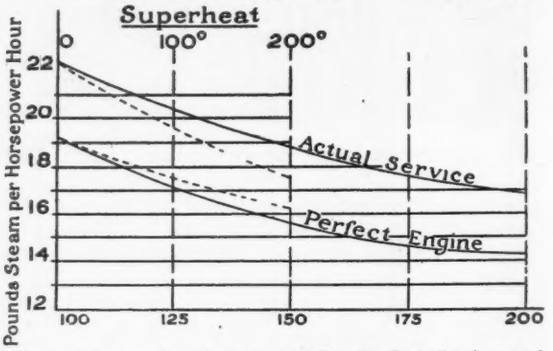
Materials for Use With Superheated Steam.

Where boiler pressures are high and a comparatively high degree of heat is used it is necessary to pay special attention to the materials and construction of the piping system. The following points are worthy of note in this connection: Screw joints in piping are not generally desirable with superheated steam. This makes necessary the use of welded flange, Van Stone or similar joints. For this work piping made from open-hearth steel is more desirable than ordinary wrought-iron piping, because it can be properly worked since it contains less carbon and its quality is more uniform. Fittings are now manufactured especially for superheated steam, and for this purpose are entirely satisfactory. A point to be watched is that the fittings as purchased from the manufacturers are specified as being intended for use with superheated steam. Of course, as a matter of good practice it is well to limit the number of fittings as much as possible by the use of welded joints and bends in the pipe.

The best valve obtainable should be used for superheated steam. There is a general impression among the engineers that globe valves and angle valves are more apt to prove steam dry after a period of use than gate valves, although the gate valve has the advantage of causing a much smaller drop in pressure due to its design permitting a straight flow of steam. A piece of steel 6 ins. long when heated to 500 deg. F. will expand 0.019 in. This fact shows that the variations in the coefficient of expansion of the metals of which they are constructed will have an important effect on the performance of valves in setting tight. Therefore valve setting is a point which should be watched.

Authorities state that cast iron should not be used at temperatures which they variously specify as ranging from 480 to 575 deg. F. Above this temperature the limit of elasticity in cast iron is

reached with a pressure ranging from 150 to 175 lbs. Under such conditions the material is strained and does not resume its former shape, eventually showing surface cracks which continue to grow until the metal parts. From this it follows that iron castings are not suitable for either fittings or valves in superheated steam work. Cast steel is, undoubtedly, the best material for both valves and fittings. This metal is capable of withstanding all temperatures and pressures



Effect of increasing Superheat With Perfect Engine and in Actual Service.

up to at least 800 deg. F. without showing any appreciable weakness. High temperatures have a pronounced effect upon the breaking strength of brass and bronze, and these materials should not be used with superheated steam as they will soon get out of shape and eventually break.

Copper or bronze gaskets are looked upon with disfavor by many engineers for superheated steam work. Among types which meet with favor are corrugated soft Swedish-steel gaskets and corrugated-copper or bronze gasket surrounding asbestos.

Special Points and Problems in Operation of Superheaters.

There are times when in the ordinary use of a superheater the circulation of steam will be less than at others. At such times superheaters may be exposed to the furnace gases at high temperature, such a condition occurring when the load is temporarily arrested or when cutting in the boilers. To take care of such conditions some superheaters are provided with flooding arrangements by which the superheater tubes are filled with water and it is made part of the evaporating surface of the boiler. To do this it is necessary to open and close certain valves on each boiler, an operation which must be reversed when the critical period is over and the superheaters are to resume their normal function.

Admitting water to the interior of the superheater induces a formation of scale in the tubes. Moreover, a superheater which has been flooded must be drained before being put back into service. This necessitates a double operation on each boiler on the part of the attendant, which must be carried out with great care and intelligence because of the disastrous results to the engine which might follow if the water in the superheater were driven into the steam pipes. This danger of flooding is one which has been so well recognized that superheater manufacturers are getting away from it by protecting their superheaters by means of heavier or special construction so that they will not burn during these special periods.

Superheaters which are not flooded should be equipped with a drain so that they may always be blown out. On starting a boiler that has been cold the drain should be opened and kept open until steam appears. This will blow out the water that may have condensed in the tubes when the boiler cooled after being shut down.

Another thing that should be carefully watched in all boiler plants is the setting of the superheater safety valves. These should always be set to "pop" first. When this is done, if the plant loses its load for any reason, there will always be a flow of steam through the superheater.

ELECTRIC RAILWAYS APPROACHING STABLE BASIS.

An official report on the national condition of the electric railway industry for the year ending Jan. 1, 1921, compiled by the American Electric Railway Association, indicates a gradual and steady approach to a stable basis. This situation is largely due to the fact that regulatory bodies, recognizing that granting of the claims of electric railways for fair rates of return is essential to the maintenance of good service, have steadily ordered relief throughout the country. These regulatory bodies also seem to be cognizant of the fact that rehabilitation of lines will be a slow process and that at least the present advanced rates must be maintained for some time even if falling costs, anticipated but not realized as yet, should come.

The report shows that 548 cities in the United States, representing more than 90% of the riding population in cities, are paying fares ranging from 5 cents with a 1-cent transfer charge to a flat rate of 10 cents. The immediate result of the widespread inclination to adjust rates upward to the requirements of good service is found in the low number of electric railway receiverships for 1920. There were only 16, representing a total capital stock of $25,313,655, as compared with 48 receiverships, representing a capital stock of $221,259,354, in 1919. During the year 450 miles of track were dismantled and 308 miles of track abandoned.

PROJECT TO ELECTRIFY BRAZILIAN RAILWAYS.

The project under public discussion for several years, rendered of great importance by the world coal crisis, to electrify the Central Railway of Brazil, the lines of which are conveniently accessible to water power for the generation of electricity, has been passed by the Chamber of Deputies. This bill authorizes the government to spend not more than 45,000 contos (about $11,000,000) for the purpose of transforming that road from steam to electrical traction, in whole or in sections, as is found most feasible. The bill also authorizes the government to contract with a private enterprise to furnish the necessary power for not more than 15 years. The state legislature of Sergipe has authorized its government to contract a loan of 15,000 contos (about $3,800,000) to be used in electrifying urban traction and other activities.

Coal Washing at the Northwest Experimental Station

Differences in Specific Gravity of Coal and Refuse Facilitate Separation — Plant Prepared to Recover 150,000 Tons of Culm in One Dump — Experiments Determine Procedure With Various Fuels

By EARL R. McMILLAN
Assistant Mining Engineer, Bureau of Mines.

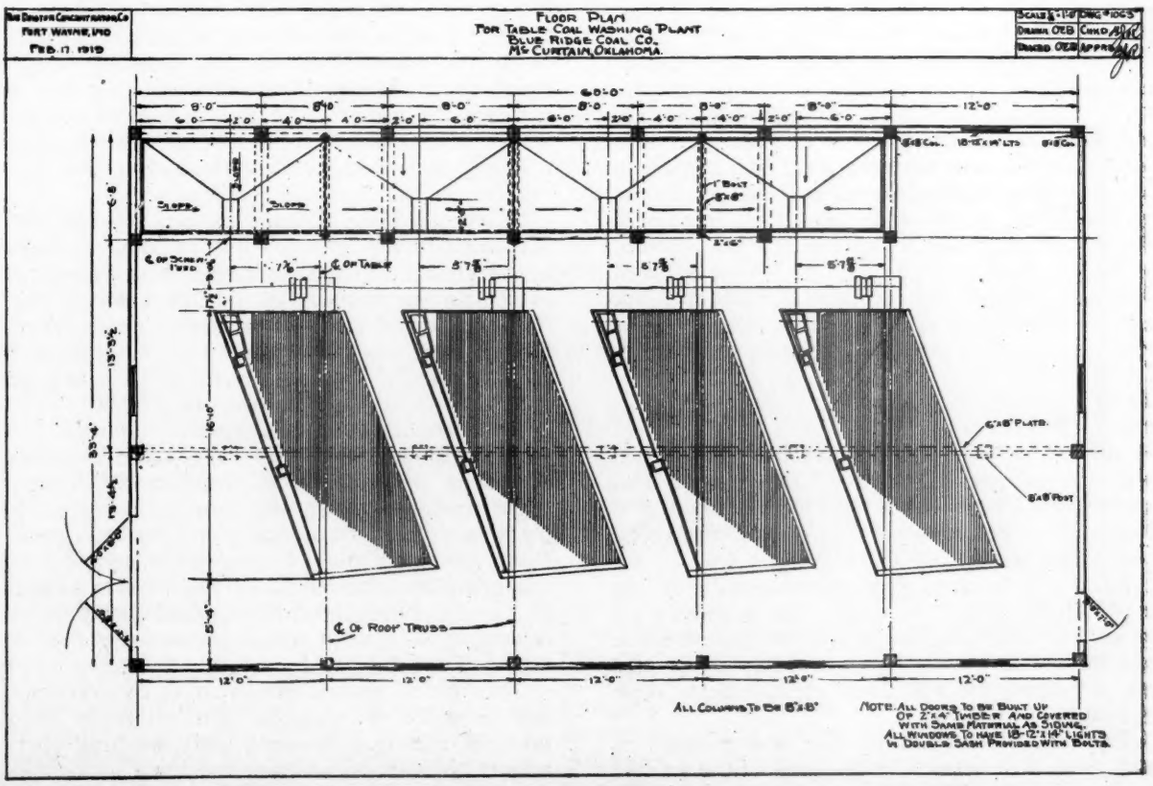
Coal washing commands the thoughtful attention of a steadily increasing number of people. Clean coal is not merely a luxury but is rapidly becoming a necessity in some industrial operations.

Coal seams in the Northwest are rarely free from "bone" and shale or clay partings which vary from a fraction of an inch to several feet in thickness. Nearly all of the coal measures are folded and faulted, the coal seams dip at various angles, and in some cases are badly broken. In mining these seams fragments of the roof and floor, as well as partings of impurities within the seams, unavoidably become mixed with the coal, so that the raw coal as it comes to the surface often contains as much as 50% by weight of waste.

At the Bureau of Mines experiment station at Seattle, the washing of this coal in order to improve it for commercial use has been studied. Since the process of coal-washing depends upon differences in specific gravity between the clean coal and its associated impurities, the first problem undertaken was that of determining the specific gravity of the clean coal and of each parting of impurity contained in a large number of representative seams.

It was found that the freshly mined coal is practically saturated with water, this being observed in determining the effect of moisture content upon the specific gravity of the coal particles, selected from samples of coal varying from low-grade sub-bituminous up to semi-anthracite, all of which are found in the state of Washington. The specific gravity values determined for the cleanest particles varied from 1.28 to 1.35; in general, the higher the rank of the coal the higher the specific gravity.

It was found, however, that the raw coal contained a relatively small proportion of free particles of clean coal, the greater proportion being bone, shale, and clay particles, with specific gravities ranging from 1.35 to 2.65. The float-and-sink method was used to determine the proportions of clean coal and of the heavier impurities, as well as the relations between their specific



Floor Plan of Table Coal-Washing Plant of Blue Ridge Coal Co., McCurtain, Okla.

gravity and ash content. But, in use of this method difficulty immediately arose in obtaining accurate and consistent results. It was necessary, therefore, to standardize the float-and-sink method of testing by compiling the results of a long series of careful tests. In the standardization tests it was found that the coal must be kept saturated with water throughout the tests to obtain accurate and comparable results. In order to test large samples quickly and accurately, a float-and-sink machine was built and, with experience, improved to a very satisfactory degree.

The prime object of the coal-washing tests at Seattle is to devise coal-washing methods that will prevent loss of good coal in the process of removing impurities, and to devise methods which will easily and cheaply remove the dirt and render the coal suitable for commercial purposes.

In working out this problem, co-operative studies have been made with several of the coal-mining companies and gratifying results obtained. It is hoped that this work will lead to the saving of large quantities of coal otherwise wasted and, at the same time, improve the quality of the washed product. For example, a coal-mining company in the state of Washington, for many years has been discharging sludge into a pile near the mine, which the company's engineer recently estimated at 150,000 tons. In the fall of 1919 and during the following winter, Bureau engineers took samples of several tons each of this material and made washing experiments on a coal-washing table. It was found that the ash content could be reduced from approximately 30% down to 17%, with a recovery of about 75%.

As a result of these tests and the recommendations made by the Bureau engineers, the owners of the mine are erecting a washing plant equipped with five tables, for treating the entire pile of sludge. The material in this pile now has a recoverable value of $2 per ton, or a total value of $225,000.

As a further example, it was found in a study just concluded at the plant of another coal company that the raw nut coal contained 24% ash. After washing in a jig, the washed coal was found to contain 23% ash, and 15% of the feed was discharged as a washery refuse. It was decided to study the action of the jig, using the improved float-and-sink test as a control. Float-and-sink tests, using a 1.55 specific gravity zinc chloride solution, showed that 81% of the feed to the jig floated with an ash content of 14%; 82% of the washed coal floated with an ash content of 14.9%; and 62% of the refuse floated with an ash content of 16%. These results indicate that the washed coal was improved by only 1% decrease in ash, and the good coal lost in the refuse amounted to over 9% of the feed or 11% of the total good coal in the feed.

After several days experimenting with the jig in which the length of stroke was gradually increased from 2⅜ ins. up to 3⅞ ins., and the rate of feed and refuse discharge properly determined and adjusted, the following improvements were observed:

The ash in the washed coal was reduced to 16%, with a recovery of 86%; 92% of the washed coal and 25% of the refuse floated on a 1.55 solution, the loss of good coal in the refuse being reduced from 9.3% to 3.5% of the feed.

Since approximately 250 tons a day are washed on this jig, the saving effected amounts to about 17 tons a day which, at $4 per ton, is worth $68. Services of two men formerly employed to pick the rock out of the washed coal were also dispensed with, thereby effecting a further saving of $13.60 a day, or at the rate of $0.06 per ton of coal treated.

Comments on Coal-Washing Practice by B. J. Roberts.

I have noted with considerable interest the report of Earl R. McMillan, assistant mining engineer, Bureau of Mines, on coal-washing work at the Northwestern experiment station, Seattle.

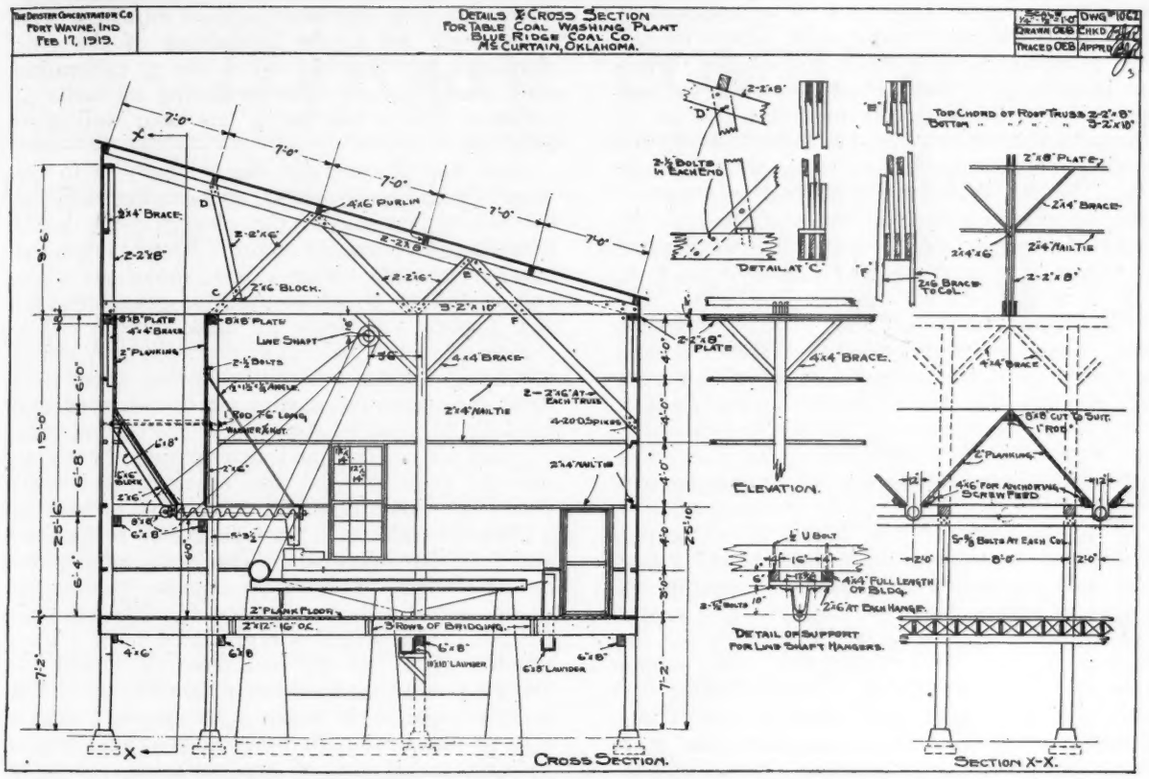
Mr. McMillan, in co-operation with the coal mining engineers and operators in the Washington field, has been making extensive investigations, particularly in the vicinity of Seattle, and his work has already proven of tremendous value to the coal industry in that district.

Owing to the folding and faulting of the coal strata, as mentioned by Mr. McMillan, lump coal, in the majority of the mines of the Washington field, is very nearly a minus quantity, while the fines—that is, that which will pass a ½-in. screen—will sometimes equal 75% of the total output of the mines. In one instance 54% of the mine-run passed a 3/16-in. mesh screen. These, of course, are extreme cases, but are mentioned for the purpose of emphasizing the difficulties to be encountered in the washing of this coal.

Coal-washing, by the use of jigs, has been in vogue for a number of years in the Washington field. Jigs and cone washers are very efficient on those sizes of coal between ½ in. and 3 ins. However, the washing action of either of these types of machines is such as to entail a heavy loss of the finer sizes. It is becoming generally recognized that the best practice in the washing of coal involves the use of both jigs and coal-washing tables, as experience has proven that this method not only lessens the cost of operation, but also reduces the coal losses to a minimum.

Shortly after the sludge tests mentioned by Mr. McMillan in his report, I had occasion to meet in conference the chief engineer and his associates of the power company owning this sludge pile. No analytic results were available at the time, but a visual examination of both the raw and washed sludge convinced me that it could be readily handled on coal-washing tables. The analytic results later confirmed my opinion. It was finally decided to build a 5-table plant with a capacity of 40 to 45 tons per hour. With some slight modifications to suit local conditions, this plant was built from the plans shown herein. Five No. 7 Deister-Overstrom diagonal-deck coal-washing tables were installed. It is located at Renton, Wash., and the washed coal product is shipped to Seattle power plants using pulverized coal.

This pile of sludge, estimated at 150,000 tons, with a value of $225,000, was produced from the coal mining company's early washing operations. It was stocked, not from any idea of its future value, but for the reason that it could not



Elevation and Details of Coal-Washing Plant of Blue Ridge Coal Co., McCurtain, Okla.

be disposed of either by setting it on fire or sluicing into the streams.

The conditions mentioned above are not peculiar to the Washington field alone. In one instance, in the Indiana field there is a large tonnage of 1¼-in. screenings being made. These screenings run 30% ash, which in ordinary times makes them unmarketable. I had occasion to make some very extensive washing tests for the owners and found that by crushing to pass a ½-in. screen the ash could be reduced to 9% and the B.t.u. increased from 9344 in the raw coal to 12,808 in the washed coal. This coal after being washed makes an ideal stoker or powdered fuel product.

The necessity for the recovery of waste fuel in the mining and washing of coal in the Washington and British Columbia fields is further emphasized by the action of the oil companies within the last year. A large number of fuel oil contracts have already been cancelled, and notification has been given that the supply of fuel oil will be cut off altogether on Dec. 31.

There are several projects now under way for the recovery, by dredging, of the fine coal allowed to run to waste in Puget Sound, from the washers on Vancouver island. The only thing which is holding this back at the present time is the engineering problems involved in the handling of the floating equipment in connection with the winds and tides on exposed shore lines.

PROTECTIVE RELAY APPLICATIONS.

In discussing the conditions arising in changing the source of power supply in a ring system of power feeders, the following statement was made on page 872 of ELECTRICAL REVIEW of Dec. 4, 1920: "Now a fault at *X*, between stations No. 2 and 6, would operate the current relay at station No. 6 set at 1 sec. and also the current relay at station No. 1 set at 0.1 sec. and isolate every substation on the loop." The statement should have given the setting of both relays as 0.1 sec., and the illustration in the lower left-hand corner of the page should have shown the relay at station No. 6 set at 0.1 sec. instead of at 1 sec.

Near the end of the same page the following wording appears: "If the loop had previously been opened between stations No. 5 and 6, and a fault were to occur at *X* close to the bus-bars of station No. 6, the current in the line at Station No. 2—." In the above quotation the word "lines" should have been used instead of "line." The direction of current flow in the relay and in the lead between the relay and current transformer should be reverse to that shown in the upper right-hand relay circuit in the illustration at the bottom of page 873.

ELECTRICAL EQUIPMENT DEVISED TO LOCATE OIL SANDS.

Instruments Arranged to Detect Reflected Waves From Surface of Oil—Tests Made to Calibrate Apparatus.

BY W. F. KERR.

It is not at all unlikely, say engineers and scientists, that before long oil inside the earth may be located and the degree of the deposit relatively determined by the use of electricity. Engineers who recently have been in Oklahoma City, Okla., to inspect the electrical apparatus for that purpose assembled by R. S. Bruner believe that he has hit upon the idea that will stand a test. He

has already made field tests in experimenting with the truckload of equipment which he has been assembling during the last few years. Without knowledge of the territory in which he was operating, and without having been advised of formations in test wells, his estimates of the depth of oil sands have been within 30 ft. of their actual depth. Where no sands had been discovered he reported that no sands existed to the depth of the instrument's range. Something like 40 setups have been made and no errors are recorded in Bruner's conclusions.

That was the record that brought scientific men here to see the apparatus. Bruner's room at a local hotel has been the scene of hundreds of demonstrations and explanations, and Bruner, himself an electrician of 20 years' experience, has explained every important thing the scientist and the layman wants to know save the one secret of the device that gives him protection.

What Mr. Bruner calls his radio oil-locating instrument consists of two engines and generator sets connected in parallel to supply the source of power, and detector units and receiving equipment. The generator sets supply d-c. energy at 40 volts. This applied to a 1-kw. motor-generator set creates 110 volts of alternating current, and this in turn produces higher voltage through a transformer. Connections are made from the high-voltage transformer through a suitable oscillation transformer, condenser and choke coils to earth contacts. This comprises the disturbing element, and the equipment is all mounted on a truck which is readily transported.

A surveyor's transit is used in making a location for a test. Five earth connections with the disturbing machinery are then made, two of them set 100 ft. apart in the magnetic north and south, and the other two at right angles and 50 ft. apart. The master earth connection is a fifth rod which is placed in the exact center of the outline of the four other earth terminals. The detector units and receiving equipment consist of three complete radio receiving instruments, two of which are evenly balanced. The third acts as a detector in approximately the same manner as a galvanometer acts toward a wheatstone bridge. Through the aid of a number of audion bulbs and honeycomb inductance coils properly connected and adjusted to the earth connections, an instrument of extreme sensitiveness is produced which reproduces the slightest variations through telephone receivers.

Working in unison with the receiving equipment are two instruments that verify by illustration that which the receiving instrument gives to the ear. One is a highly sensitive ballastic galvanometer and the other is a reproduction by photography. The two prove the different sounds heard by the ear through the receivers. Bruner is convinced that the resistance theory heretofore employed in tests with instruments of this nature is wrong. Directing his attention to radio apparatus and applying it to different substances below the earth's surface he was convinced that the different sounds obtained from distortion of wave lengths, directed and adjusted to different materials in the earth's crust, would, when calibrated to known standards, denote the presence or absence of materials to which sensitive instruments were adjusted. His experiments led to the assembling of the now completed instruments, and in the 37 calibration tests recently made near producing oil wells at different depths his theory has been well tried out.

Each test is carefully charted both as to the sound from the receivers and readings of the ballastic galvanometer, the photographic device furnishing a permanent record. Results in proven areas have come within a few feet of accuracy, and within 50 ft. of accuracy is guaranteed by Mr. Bruner. All tests are made directly below a radiated circle 100 ft. in diameter, and charts are being prepared in oil-producing areas to a depth of 4,000 ft. starting at the surface and working at 1000-ft. steps. The instrument may be used in locating and determining the thickness of veins of coal and other carboniferous products. Some time will be required in making a complete code to indicate depths of formations and their possible value. The electrical impulse at the surface produces an impulse in a strata of oil, say at a depth of 1,000 ft. The echo vibration in the strata is reproduced on a photographic plate. If the vibration in a well of known production shows a certain length of line on the negative it is taken for granted that a line of similar length in another region would indicate an oil sand of approximately the same productivity.

WESTERN ELECTRIC CO. ANALYZES LABOR SITUATION.

The frequency of accidents among shop employes has shown a considerable decrease due to the stabilization in industry brought about by the present economic conditions, according to A. E. Kidd, employment manager of the Western Electric Co. at New York City. It is very probable that this condition is due to the presence of operators and mechanics of longer experience on the job. It is stated that employes are less restive today and are not moving around from job to job, the fact that many industrial organizations are releasing their inefficient workers causing those who have jobs to hold on to them.

There is an increase in the volume of applicants, but the quality of the applicants is decidedly low. The greatest surplus of workers today appears to exist among the unskilled mechanics or those who operate one type of machine. The Western Electric Co. is now employing the largest personnel in its 51 years of existence. The figures at the end of the third quarter in September showed 34,222 workers on its payrolls.

COMMISSIONERS REFUSE BOND ISSUE BY UTILITY.

The Millville (N. J.) Electric Co. has been refused permission by the New Jersey Board of Public Utility Commissioners to issue bonds for $530,000, and has denied, as well, approval of a mortgage for $750,000. In its decision, the board says that the creation of a long-term mortgage at a high rate of interest is not justified, and would create an unreasonable burden on the customers of the company.

EDITORIAL COMMENT

Relativity of Events to Things Electrical

An assassin kills a member of royalty in central Europe and the world is thrown into a world war. A financial stringency occurs in Japan and the bottom falls out of the silk industry throughout the world. Sugar prices drop in America and a moratorium is declared in Cuba. Cafeterias, car-fares and moving-picture taxes on the Pacific Coast force the employment of the electric furnace. All this is by way of saying that almost everything is related in some way with every other thing.

The nickel or five-cent piece used to be the smallest denomination used "out west." Government taxes were placed upon moving-picture shows and ice cream sodas, and street-car fares floundered between five and ten cents. Today there is such a demand for "pennies" that the mint in San Francisco has had to put in an electric furnace to speed up its production. That this is an electric furnace is really a matter of considerable significance.

California power plants were the first to use oil fuel under boilers, the coal-fired plant being the exception. When plants were not oil fired they were operated by water; as oil went up in price and became scarcer, the hydroelectric plants grew in size and gradually increased in number. Even so, California is still the hotbed so far as oil firing is concerned. Yet the electric furnace, in face of the keenest competition, is chosen to replace an oil furnace because it can produce more cheaply than the oil-fired furnace in the one place where the oil-fired furnace should excel because oil is being produced in large quantities all around it.

The electric furnace now installed at the mint in San Francisco is of one-half ton capacity, is three-phase, and is expected to produce one thousand pounds of metal in three hours. It will be used exclusively for melting down the tin-zinc stock used for making one-cent pieces and the copper-nickel stock for five-cent pieces. The reason for adopting this furnace is that two similar ones have shown a considerable saving in the cost of production on similar work at the Philadelphia mint.

If the electric furnace can go in and supplant an oil-fired furnace in a state where oil is flowing, surely there cannot be serious competition with oil in states where oil must be transported. However, perhaps the moral of this incident is not that the electric furnace has its advantages even where it might appear at first sight to have no chance at all. But rather that whatever happens, wherever it occurs and however far-removed the incident appears to be, something electrical is involved in some manner directly or indirectly in the solution.

Contract Cancellations

In a recent statement of economic conditions issued by the National City Bank of New York the question of contract cancellations was discussed at some length. We take pleasure in quoting the following and believe it will be studied and approved by all who read it:

"The question of whether the holder of a contract, made in good faith, shall insist upon its performance is more than a matter of self interest. The holder who, weakly or from motives of policy, fails to stand for a sound principle when general demoralization of business morale is threatened contributes to that demoralization almost as much as the offenders. Honorable standards in business life will not be maintained unless somebody fights for them.

"In a situation of this kind personal influence and the power of example go a great way. If one man flinches, another will; soon it is reported that everybody does, and then it seems unfair that any one should be expected to make his word good. Custom makes standards of conduct. A delinquency of one kind provokes others, as in the case of reprisals in war. It is said that when goods were advancing orders on contracts sometimes had to wait while goods were sold at higher prices. Such practices are dishonorable, but the remedy is not in other acts tending to lower the standards and increase the demoralization.

"American exporters complain that foreign buyers in some cases are not living up to their obligations, but the charges are not all on one side. These are times when men are making reputations that will stay with them as long as they live and their houses after them, and which involve the good name of the country to which they belong. The possible gains of doubtful practices are not much compared with all that is involved. The right course is the one which if followed generally will give stability to business and protect the honest trader."

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

INSPECTORS TO CO-OPERATE WITH ELECTRICAL INDUSTRY.

Western Association of Electrical Inspectors to Consider Representation of Central Station and Other Interests on Its Executive Committee.

The Western Association of Electrical Inspectors at its sixteenth annual meeting to be held at Detroit, Jan. 25-27, will consider the advisability of bringing about a more effective co-operation between the various branches of the electrical industry and inspectors generally by admitting to membership upon its executive committee one representative from the central-staton interests and another representative from the engineering, manufacturing and contracting interests. It is felt that if this plan is adopted the association will always have the advantage of the good advice of the electrical industry in general in connection with the solution of the many problems which invariably confront an association of this character.

Since the tentative program was outlined in the Dec. 4 issue of ELECTRICAL REVIEW there has been a number of minor changes, which are noted below:

Jan. 25, 2 p. m.—General subject of "Grounding of Electric Circuits and Apparatus": (b) "The Central Station's Responsibility," by A. A. Meyers, electrical engineer of the Detroit Edison Co.; (c) "Municipal Co-operation," by Gerald J. Wagner, director of public service, Grand Rapids, Mich.; (d) "The Grounding Rules," by W. J. Canada, director of engineering, National Electric Light Association; (e) "The Electrical Contractor's Responsibility," speaker's name withheld by request. General subject of "Safeguarding Electric Fixtures": (a) "Manufacturing and Shipping Problems," by Charles H. Hofrichter, secretary-treasurer of the National Council of Lighting Fixture Manufacturers.

Jan. 26, 10 a. m.—General subject of "Improving Old and Defective Wiring Installations": (b) "The Underwriters Inspector's Method," by Frank R. Daniel, chief engineer of the Wisconsin Inspection Bureau, Milwaukee.

THRIFT DISCUSSED BY NEW YORK ELECTRICAL SOCIETY.

An address on "Benjamin Franklin and Modern Ideas of Thrift" by Henry L. Doherty, who is today recognized as one of the leading American exponents of thrift, was the feature of the 388th meeting of the New York Electrical Society held Wednesday evening, Jan. 12. Mr. Doherty, who is a past president of the society, strongly urged that each and every one get behind the movement to encourage universal thrift. If the lesson of thrift can be learned by the people of this country, the speaker said, it will cure the nation's ills.

In comparing conditions in Franklin's time with those of today, Mr. Doherty expressed the belief that thrift was more universally practiced then than now. Being thrifty does not mean that people should hoard money, but rather that they should put a stipulated amount of their earnings each week or month into sound investment securities. He pointed out that the investment offerings of most financial houses were of such large denominations as to make it impossible for the man of moderate means to take advantage of them and said it was his idea to market securities in such denominations that all could have an equal opportunity for investment.

I. E. S. AND FIXTURE MEN HOLD JOINT MEETING.

Removable Fixture Outlets Discussed by Manufacturers' Representatives and Contractor-Dealers—Definite Type of Outlet Agreed Upon.

In opening the joint meeting of the New York Section, Illuminating Engineering Society, with contractor-dealers and fixture manufacturers and dealers, held Thursday evening, Jan. 13, at the Engineering Societies building, New York City, for the consideration of the subject of "Removable Fixtures," O. H. Caldwell, in presenting "What the Idea Is," described the purpose of the change and enumerated the advantages resulting through its adoption to the fixture maker, dealer, contractor, builder, landlord, tenant and householder.

In discussing "Its Relation to Better Lighting," M. Luckiesh stated there was nothing to lose but much to be gained in having removable fixtures and the usual unprofitable work in the fixture trade of reinstalling refinished decorations would be eliminated. Also the erroneous idea about the high cost of lighting in the average home would be eradicated, providing one standard outlet device rather than a number was adopted. The only reason at present in the way of completely adopting the idea is the difficulty of removing present fixtures.

W. R. McCoy, in presenting "The Fixture Man's Viewpoint," and speaking on behalf of the New York Division of the National Council of Lighting Fixture Manufacturers, said that one type of outlet box should be adopted and that the best that money and brains could produce. The reasons for the fixture manufacturers endorsing the plan were that better workmanship on the part of the electrician would result and the need of expert mechanics proving up the fixtures before installation would not be necessary.

"How It Affects the Contractor-Dealer" was the subject assigned to W. J. Shore. In developing the topic he divided the electrical work on the average job into installation of wiring, etc., preparation of the fixtures themselves, and labor and material in the hanging. He stated that with removable fixtures the first part of the work

would be simplified and the second eliminated, but the profit to the contractor-dealer would be about the same. However, there would be an advantage in doing away with the preparation of the fixture since expert skill is required for it while the installation wiring could be handled by the men already on the job. In addition, by the change more fixtures would be bought by the householder and not by the landlord and hence more business would go to the contractor-dealer instead of to the manufacturers. In conclusion Mr. Shore said that standardization must be followed and while the use of more outlets might develop an objection in the form of overloaded circuits, all would be benefited by the change.

After the addresses the ceiling and wall-bracket removable fixture outlets, made by the Electric Outlet Co., New York City, were described and shown by Ben Pousley. H. R. Sargent, General Electric Co., stated that at a recent meeting of representatives from the Benjamin Electric Manufacturing Co., Cutler-Hammer Manufacturing Co., General Electric Co., Hart & Hageman Manufacturing Co. and Harvey Hubbell, Inc., a definite type of outlet had been agreed upon by these manufacturers.

Dana Pierce, Underwriters' Laboratories and National Fire Protection Association, said that fixtures were better made today from the standpoint of safety—fire and electrical—due to the tendency toward grounding the fixture rather than insulating the joint. He also called attention to the 660-watt regulation in the National Electrical Code and the need of conforming to it, but believed that the underwriters would not stand in the way of the safe development of the removable fixture.

CONTRACTOR-DEALERS HOLD EXECUTIVE MEETING.

Plan Adopted by New York Electrical Association to Redistrict State and Appoint Field Man to Superintend Organization Work.

Among the plans adopted at the annual executive committee meeting of the New York State Association of Electrical Contractor-Dealers, held in Albany Jan. 12-13, was one proposed by Secretary J. P. Ryan for geographically dividing the state into 34 districts. The executive committee will now consist of 38 members instead of 20, and it was decided by the new committee to elect from its membership a management committee of five with the executive committee chairman and the secretary as members ex-officio.

F. A. Mott, Rochester, was elected chairman of the executive committee, while James F. Burns and J. P. Ryan were re-elected treasurer and secretary respectively. The present members of the management committee are: Peter McGeady, New York City; F. W. Newman, Albany; James F. Hilton, Syracuse, and C. C. Mill, Oneonta. The committee was empowered to elect the fifth member.

A resolution was adopted authorizing the appointment of a field man to attend to district organization work, new membership campaigns and other association activities. Efforts will be made in 1921 to increase the present membership of 575 to at least 900.

It was voted to hold the next annual meeting in Buffalo, July 19, just previous to the opening of the twenty-first annual convention of the National Association of Electrical Contractor-Dealers in the same city.

At the Thursday afternoon meeting Jacob H. Herzog, vice-president of the Commercial National Bank & Trust Co., Albany, in speaking about the present financial conditions, presented convincing reasons why merchants should replenish their stocks now and not let them run down. Samuel A. Chase, Westinghouse Electric & Manufacturing Co., as a preface to his talk on "Harmonizing the Industry," paid high tribute to W. L. Goodwin and his work. S. G. Hibben, Westinghouse Illuminating Engineering Bureau, gave a practical talk on how the electrical contractor-dealer can use illuminating engineering to increase his business.

ACTIVITIES OF THE N. E. L. A. OUTLINED FOR 1921.

Good-Will Advertising and Public Information Campaign in Co-operation With Electrical Interests Among Important Matters Included in Program.

A statement of the scope of the present activities of the National Electric Light Association, sent out recently from its headquarters, sets forth the purpose of the association in the following words: "To advance the art and science of the production, distribution and use of electrical energy for light, heat and power for public service." In striving to carry out this purpose the association has for many years had the assistance of the trained leaders of the industry, and its activities have been divided into four general sections, viz., accounting, commercial, electric vehicle and technical. In addition to these there has been a number of national standing and special committees to work out problems connected with questions of general interest not exclusively included within the scope of activities of any of the four sections mentioned.

A little over a year ago a plan was conceived whereby the association might be of even greater benefit to its member companies and to the industry as a whole. This plan called for increased activities along certain lines, particular attention being given to the matter of public relations. Subsequently at the Pasadena convention the constitution was revised to care for the development of this plan and of increased activities, some of which already had been begun under special authority of the national executive and public policy committees. In addition to many more or less detailed changes in the constitution a revision of the organization was made by providing for the division of the country into 12 geographic divisions and the inclusion of Canada as a whole as the thirteenth geographic division. Another change covered the consolidation of the electric vehicle section with and subordinating it to the commercial section, and the creation of a new national section known as the public relations national section to carry on activities pertaining to the public, the regulatory bodies and the electric light and power industry. Owing to conditions which have grown up in this country and which not only are present but which may be ex-

pected to continue for the next several years, the work of this newly created section was begun immediately and is being carried on aggressively and systematically.

In addition to the very extensive committee work which has been carried out during the years of the association's existence, the program includes specialization in engineering through the engineering department, which is directly under the technical section. The work of this department includes such important matters as inductive interference, safety rules, standardization, specialization in accounting and in furnishing statistics and detailed information through the service department, which co-operates with the accounting section. The work of the accounting section includes the preparation of a uniform classification of accounts and assisting the Federal Water Power Commission in the preparation of an accounting system.

ACTIVITY IN ORGANIZING STATE COMMITTEES ON UTILTY INFORMATION.

The national good-will publicity campaign has taken concrete shape and is in active operation. Member companies have given their hearty support to the campaign and have sent out millions of pieces of literature prepared by the publicity department. The interest of investment bankers, public utility commissioners, insurance men and others has been secured. The preparation and sending out of pamphlets has been but a small part of the publicity program. This department has taken the lead in the organization of state committees on public utility information throughout the country, 11 states already having been organized with committees or bureaus composed of representatives of all classes of public utilities and having for their object the dissemination of facts and figures regarding public utility development. The organization of similar committees is practically assured in nine additional states, with utility men in several other states evincing considerable interest. This all ties in with the national good-will publicity campaign of the association, which now is crystallizing so that definite announcement concerning it may be given to the public.

Realizing that the development of the entire electrical industry depends primarily upon the prosperity and development of the electric light and power industry, the association has been working toward a co-operative campaign in which manufacturers of electrical machinery, equipment and supplies would join with paid advertisements in popular magazines, newspapers and trade journals, supplementing a direct advertising campaign by the N. E. L. A. The association's own direct advertising campaign will begin Feb. 19 with a one-half page advertisement in the *Saturday Evening Post,* in subsequent issues of which will appear 12 similar advertisements.

Division of the country into geographic divisions will mean the intensive development of the work of the N. E. L. A. in each of these divisions. A department of lighting recently has been established and the industrial lighting exhibit will be demonstrated in many of the principal cities of the country. Demonstrations already have been held during the last few months and an itinerary has been tentatively arranged and is being completed as rapidly as possible.

Summarized it appears that the most important national activities for 1921, in addition to the committee work, include a co-operative program with the Investment Bankers Association of America; the national good-will advertising and public information campaign in co-operation with the manufacturers, jobbers and contractor-dealers; also to lend assistance in the formation of additional state committees on public utility information and the preparation of national news items for state committee and member company use and in popular magazines. In addition the program provides for co-operative efforts with the National Association of Railway and Utilities Commissioners on the subjects of finance, service, etc. The establishment of a basis for a national inductive interference program to be followed by joint committee activity on the part of the telephone and electric light and power companies is also contemplated. A program of public utility information to be presented to and through insurance companies, bankers, chambers of commerce, rotary clubs, etc., and a continuing effort to bring about an economical and feasible plan of upbuilding the industry through the geographic divisions, state associations or sections and national committees and sections at headquarters is also planned.

WISCONSIN CONTRACTOR-DEALERS MEET IN MILWAUKEE.

Finances, Affiliation With Master Builders and Time-Payment Sales Are Chief Features of Discussion in Annual Convention.

More than 100 electrical contractors and dealers met in Milwaukee Jan. 19-21 for the fourth annual convention of the state association. So interested did the members become in the numerous subjects presented by the speakers that extended discussions prolonged the program over the original two-day schedule, and for the purpose of bringing up subjects not included in the regular program an extra session was held on the morning of Jan. 21.

At the general business session which preceded the regular convention Wednesday morning one of the important subjects discussed was that of the pending wage readjustment and its probable effect upon electrical workers. There was a majority sentiment among the electrical contractors present that the electrician is superior to other craftsmen and while he had been paid less than other trades in the past, the readjustment period is the proper time to see that pay of electrical workers is not reduced in the same proportion as other workers.

While it was the general feeling that the wage of electricians be not permitted to fall below $1 an hour, a resolution was adopted recommending co-operation of local contractor-dealer organizations with organizations of master builders and building contractors in restraining inordinate demands of labor. At a regular session later the members were addressed by O. H. Ulbricht, secretary of the Wisconsin Master Builders' Association, who urged electrical contractors to join

the builders for the purpose of co-operating in the solution of operation and labor problems and the securing of needed legislation.

"Financing a Contractor-Dealer Business," the subject presented by P. C. Burrill, secretary of the Herman Andrae Electrical Co., Milwaukee, brought out extended discussion which was led by John Piepkorn, of the Piepkorn Electric Co., and H. F. Brauns, of the Home Wiring Co., both of Milwaukee. Mr. Piepkorn started the discussion regarding time payment in the sale of appliances by advocating a shortening of the term of payments to not over 12 months and charging more than the usual 5% additional to such customers. He also advocated the expenditure of at least 10% of sales for advertising purposes.

In his analysis of the merchandising business Mr. Burrill said it fell naturally into three departments, finance, sales and service, and outlined an ideal establishment in which the dealer should have approximately $50,000 to invest before he opened his doors. Discussing the subject from the contractor's point of view, Mr. Brauns said that where accounts receivable were allowed to stand uncollected 90 days or more, the working capital and credit of the contractor would rapidly become exhausted. He advocated an accounting system and rigid collections based on 45 days at the utmost. He also condemned the practice of contracting on the basis of the number of outlets to the installation.

"Who's Who in Electrical Rules," a paper by George B. Muldaur, of the Underwriters' Laboratories, Chicago, gave the contractors many interesting facts regarding the co-ordinating methods of developing codes and the examination, listing and labeling of electrical supplies and appliances. J. J. Stanton, Milwaukee representative of the Westinghouse Electric & Manufacturing Co., introduced better features in the retailing of appliances.

Other papers that received commendation and invoked much discussion were: "Ideal Co-operation Between Central Station and Contractor-Dealer," by J. P. Pulliam, vice-president Wisconsin Public Service Co.; "Visualizing the Future," by Samuel C. Chase, discussed by J. J. Kelly and P. C. Burrill; "Value of the National Association," by A. Penn Denton, Kansas City, Mo. The sessions were presided over by B. L. Burdick, of the Burdick Electric Co., Mliwaukee.

ELECTRIC TRUCK TO BE FEATURED AT NEW YORK SHOW.

In connection with the electric vehicle show to be held under the auspices of the New York Edison Co. Jan. 29-Feb. 12, many electric vehicle manufacturers have signified their eagerness to join in the effort to make this exhibition an unqualified success. Dealers in accessories also expressed their willingness to co-operate and support the movement. The need for an "all electric truck show" has long been felt and the present development marks another forward step in the advancement of an industry which already great is destined to become greater. The five-ton electric truck belonging to the New York Edison Co., which recently made a long-distance run from Philadelphia to New York City, will be on view among others.

Although a great impetus has been given the sale of electric trucks and accessories during the past year on account of the attention paid this source of revenue by the light and power companies, there is still an opening for more extensive activities. It is to be hoped that the exhibition scheduled to take place in the Edison showrooms will not alone stimulate such activity, but will result in a more widespread recognition of the merits of the storage-battery vehicle.

COMMONWEALTH STOCK OFFERED TO GENERAL PUBLIC.

In its customer-ownership plan the Commonwealth Edison Co., Chicago, has for the first time adopted the policy of reaching the public through the local newspapers. Heretofore the company has conducted its stock sales campaigns to the public through the medium of its employes. In its latest plan local residents are offered the opportunity of purchasing stock either for cash or on the monthly savings basis. The company's decision to offer its capital stock to residents of Chicago is prompted by the conviction that the chance to participate in profits should go first of all to those who make profits possible.

Announcing—
An Opportunity
For You to Share in the Earnings of the Commonwealth Edison Company
Through the adoption of a plan which permits customers of the Commonwealth Edison Company to subscribe for the Company's Capital Stock, either for cash or on the monthly savings basis, local residents are now offered the opportunity to share in the earnings of one of Chicago's largest, oldest and fastest-growing industries.
A Few Dollars a Month Makes You a Profit-Sharing Stockholder
Every person who can save a few dollars a month can easily become the owner of a few shares of stock in this company.
The stock is offered to customers of the company and local residents at a price of $105 per share on monthly payments, $10 to be paid with subscription, balance $10 per month. Shares can be bought for cash at the current market price.
The Commonwealth Edison Company is recognized as one of the soundest and most efficient public utilities in the country and its Capital Stock is everywhere regarded as a safe investment.
The dividend rate is high—$8.00 per share per year. Since 1889 quarterly dividends have been paid without interruption.
We urge you to make your reservations today.
Investment Department
Commonwealth Edison Company
Room 1110, 72 W. Adams Street

Publicity Matter Utilized in Chicago Newspapers to Sell Central-Station Stock.

A. I. E. E. AND A. S. M. E. TO HOLD JOINT MEETING.

The subject of "Marine Electrical Engineering" will be taken up Jan. 28 at a joint meeting of the Metropolitan Section, American Society of Mechanical Engineers, and the New York Section, American Institute of Electrical Engineers, in the Engineering Societies building, New York City. Alfred E. Wall, chief engineer of the

Ward Leonard Electric Co., will preside. Addresses will be made on "Electricity Applied to Ship Auxiliaries," by H. L. Hibbard, manager of the marine department, Cutler-Hammer Manufacturing Co., and formerly chief of the Bureau of Construction and Repair of the United States Navy; "Electrical Terminal Facilities," by Commander C. S. MacDowell, inspector of engineering material, United States Navy; "Electric Ship Propulsion," by Eskil Berg, engineer of the turbine department, General Electric Co., and "Ship Propulsion," by Walter Thaw, marine engineer, Westinghouse Electric & Manufacturing Co.

ELECTRIC WELDING DISCUSSED AT NEW YORK MEETING.

A paper on "Electric Welding With Alternating Current" was read by C. J. Holslag, Electric Arc Welding & Cutting Co., Newark, N. J., at the monthly meeting of the Metropolitan Section of the American Welding Society held in New York City Jan. 18. A representative of the Oxweld Acetylene Co., Newark, N. J., also presented a paper on "Oxyacetylene Welding and Cutting." Both papers were illustrated with lantern slides.

ELMIRA SHOW WILL FEATURE ELECTRICAL APPLIANCES.

The Elmira Electrical Association will hold an electrical show at 311 North Main street, Elmira, N. Y., Jan. 22-29, the primary object of which is to educate the people of that section in the uses of electrical appliances. To that end, therefore, it is planned to confine the exhibits as far as possible to household appliances, all of which will be demonstrated. Local manufacturers, jobbers and dealers to the number of 50 will be represented by various exhibits.

ELECTRIC COMPANY ATTACKS CONNECTION RATE ORDER.

The Public Service Electric Co., Newark, N. J., following the refusal of the Board of Public Utility Commissioners to allow a connection charge, has carried the case to the Supreme Court, and Chief Justice Gummere has granted a writ of certiorari to review the order of the board dated Nov. 23. The company holds that the order is without warrant in law; that it is not reasonably supported by the proofs taken before the commission, and that it violates the constitutional rights of the corporation, taking for public use its property without due compensation. Further, that it denies the company equal benefits of the law.

In its contention the company points out that in the introduction of its business and in its desire to obtain customers it made connections for service without charge. Later, by reason of increased cost and expenses for labor and material and increased demand for additional and more expensive service, the capital outlay of the corporation grew unduly burdensome and it became necessary to reduce it. Accordingly on Aug. 12 last a schedule of rates was drawn up providing under certain circumstances for the payment of the cost of wires and conductors run upon private property of a consumer to be paid by him. These rates, it is held, were entirely reasonable and conformed to charges made by other companies for similar service. This schedule of rates was refused by the utility board.

ELECTRICAL AND MINING MEN DISCUSS POWER PROBLEMS.

The Pittsburgh Sections of the American Institute of Electrical Engineers and the American Institute of Mining Engineers held a joint meeting Jan. 21. The papers read and discussed were "Power Rate for Coal Mines," by H. C. Bailey, consulting engineer, Columbus, O., and "Gathering in Coal Mines," by R. L. Kingsland, superintendent of power and mining department, Consolidated Coal Co., Fairmont, W. Va. An inspection trip was made by the delegates through the buildings of the Bureau of Mines, Pittsburgh.

PLANS OF WESTINGHOUSE MERCHANDISING BUREAU.

In connection with a meeting of the salesmen of the McGraw Co., at Omaha, Neb., Jan. 22-25, at the Hotel Conant, a "Better Merchandising Show" will be given. This is the first of a number of cities in Nebraska, South Dakota and Iowa to be visited by the bureau, Sioux City, Ia., being next on the list. From Jan. 31 to Feb. 5 shows will be held in Detroit under the auspices of the Commercial Electrical Supply Co.

COMING CONVENTIONS.

Associated General Contractors of America. Second national conference, New Orleans, La., Jan. 25-27. Headquarters, Hotel Grunewald. Secretary, 111 West Washington street, Chicago.

Western Association of Electrical Inspectors. Annual convention, Detroit, Mich., Jan. 25-28. Headquarters, Hotel Statler. Secretary, William S. Boyd, 175 West Jackson boulevard, Chicago.

Iowa State Association of Electrical Contractor-Dealers. Meeting in Davenport, Ia., Jan. 26-27. Headquarters, Blackhawk Hotel. Secretary, F. Bernick, Jr., Oskaloosa, Ia.

Pennsylvania State Association of Electrical Contractors and Dealers. Annual convention, Philadelphia, Jan. 26-27. Secretary, M. G. Sellers, 1518 Sansom street, Philadelphia.

National Council of Lighting Fixture Manufacturers. Annual convention and lighting fixture market, Elmwood Music Hall, Buffalo, N. Y., Feb. 14-19. Secretary, Charles H. Hofrichter, 8410 Lake avenue, Cleveland.

American Institute of Electrical Engineers. Midwinter convention, Engineering Societies building, New York City, Feb. 16-18. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

Joint meeting of Illinois State Electric Association, Illinois Electric Railways Association and Illinois Gas Association, Chicago, March 15-17. Headquarters, Sherman House. Secretary, R. V. Prather, Springfield, Ill.

Wisconsin Electrical Association. Annual convention, Milwaukee, March 22-24, jointly with the Wisconsin Gas Association. Secretary, J. P. Pulliam, 1408 First Wisconsin National Bank building, Milwaukee.

North Central Electric Association. Annual convention, Duluth, Minn., June 14-16. Secretary, H. E. Young, 15 South Fifth street, Minneapolis, Minn.

American Institute of Electrical Engineers. Annual convention jointly with the Pacific Coast convention, Salt Lake City, Utah, June 20-25. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

BOOKLET DESCRIBES FUNCTIONS OF BYLLESBY ORGANIZATION.

Utility Companies Under Management of H. M. Byllesby & Co. Serve Communities With a Population of Over Two Million People.

A booklet outlining the scope and services of the Byllesby organization, which is described as "a nation-wide organization founded on constructive service to the growing daily necessities of people, cities, farms and industries," has been issued by H. M. Byllesby & Co., Chicago. It is pointed out that as investment bankers the company is responsible for the distribution of securities amounting approximately to $323,600,000, of which about $63,900,000 has been retired, leaving outstanding $259,700,000 par value owned by investors throughout the United States. In its engineering and management capacities the organization has installed 230,000 hp. steam-electric capacity and 105,000 hp. hydroelectric capacity, and exercises management functions over electric and gas companies serving 500 cities and towns with 2,200,000 population in 16 states.

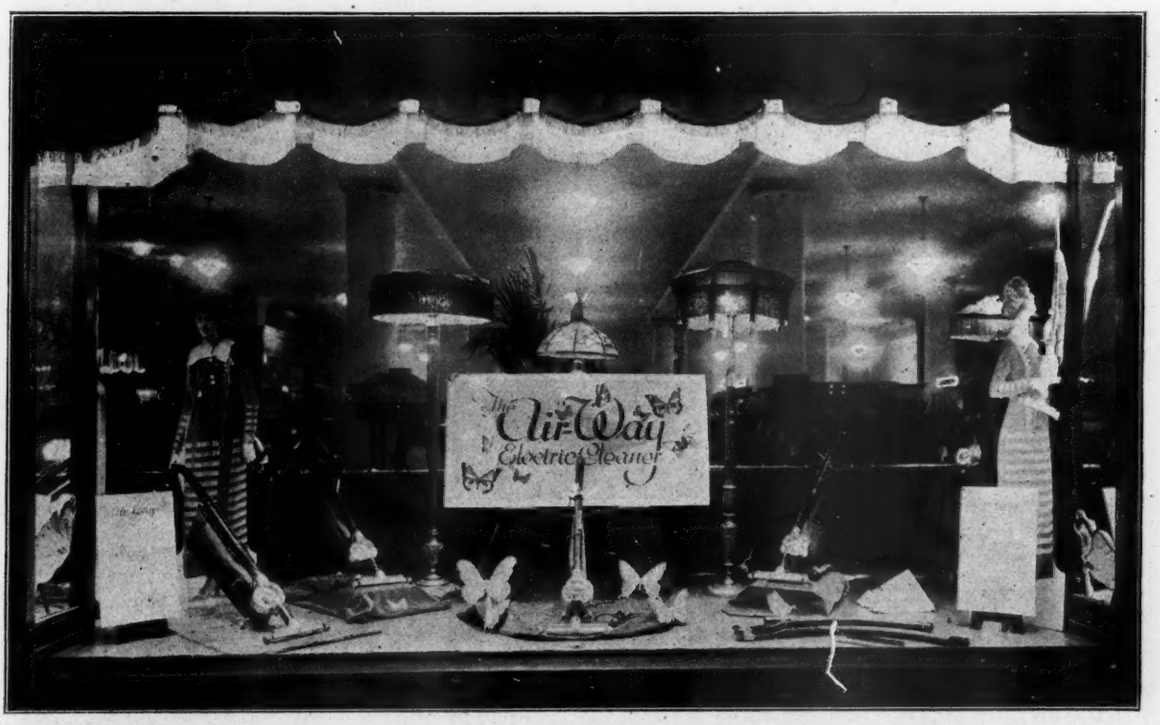
The Byllesby companies now have approximately 20,000 home shareholders directly interested in their welfare. Of the total electrical output, now amounting to nearly 800,000,000 kw-hrs. annually, 47% is produced by water power. Several chapters in the booklet are devoted to the Shaffer Oil & Refining Co., Oriental Navigation Co. and the retail mail-order house of Leonard Morton & Co. Earnings figures of the Byllesby utilities show that the present business is two and one-half times that transacted ten years ago. Gross earnings of companies, the securities of which are sponsored by H. M. Byllesby & Co., now exceed $50,000,000 annually.

BUILDING UP CONFIDENCE IN PUBLIC UTILITY.

Novel Plan to Gain Confidence of Public and Employes Inaugurated by President of Kings County Lighting Co.

A solution for the problem of successfully operating a public utility corporation has been worked out by Ralph Elsman, president of the Kings County Lighting Co., Brooklyn, N. Y., whose creed is simply a belief in the power of common understanding. He believes public utility corporations can succeed only when they have a point of direct contact with the community they serve. Firmly committed to that creed he has

Vacuum Cleaners Featured in Central-Station Window Display



To stimulate the sale of vacuum cleaners the Toledo (O.) Railways & Light Co. recently arranged an attractive window display of these electrical devices, with a background of artistic lamps. One of the interesting features of the exhibit was that it afforded an unobstructed view of the inside of the store.

bought the controlling interest in the company of which he is now the head, borrowing on his individual credit a sum reported to have been in the neighborhood of $1,000,000 to do so. On the strength of that same faith he plans to issue securities of the company for $2,000,000 more and sell them to the patrons of the company. The money will be used to place the utility in a better position to serve the public.

In announcing his program Mr. Elsman summed up his plans as follows:

(1) Immediate enlargement of plant and facilities to the limit of our financial ability.
(2) Mutual co-operation between company and community.
(3) Opportunity whereby consumers may be partners in the company.
(4) Upbuilding of public confidence that the company can be relied upon for dependable and adequate service.
(5) Recognition by the company of its employes for their loyalty and devotion to the company and courtesy and service to the public.
(6) Recognition of the public interest in a public service corporation in respect to its entire business.

"As a part of my plan to carry out these ideas I intend to have on the board of directors of the company a representative of the consumers and a representative of the employes," said Mr. Elsman. "Thereby I believe there will be built up, based on complete knowledge of all the facts, complete confidence and co-operation in and by the company, its employes and its consumers."

PROBLEMS FACED BY COMMERCIAL DEPARTMENT OF UTILITY.

Empire Gas & Electric Co. Finds Overhead Cost of Handling Appliances Has Steadily Risen and Suggests Method of Reduction.

In commenting on the present situation confronting the commercial departments of the central-station companies, William F. Moses, commercial manager of the Empire Gas & Electric Co., Auburn, N. Y., recently said: "This corporation has a chain of offices all within a radius of 40 miles, each maintaining a sales floor where its consumers can purchase dependable electrical merchandise and be sure of service after the installation. One central purchasing department insures economy in buying and guarantees maximum discounts.

"We have always believed in maintaining list prices as quoted by manufacturers in all our appliance sales, holding such prices to be fair and just. Within the past few years of abnormal conditions though our viewpoint has changed in the matter of discounts given by manufacturer and jobber. Up until the present month (December) overhead costs have steadily risen. The cost of handling, demonstrating and selling the larger appliances has likewise soared higher and higher until at this time cartages, demonstrations and sales commissions leave so little net profit that the new-business or appliance department's chance of being on a self-supporting basis is getting smaller and smaller.

"To be sure, the commercial department of an electric corporation should not be conducted strictly for profit. Our first objective is to sell kilowatts, but in so doing there is no reason why a fair and reasonable profit is not to be expected in the sale of these modern electrical servants. It is my opinion that in the majority of cases discounts should be increased to alleviate the above-named conditions, even if lists have to be correspondingly increased."

Along with the above problem, Mr. Moses points out another which is very similar, and that is the present downward trend of the market for food and clothing. Being aware of this the buying public is asking why the same thing should not apply to electrical devices. The answer is simple enough to those engaged in the electrical industry, Mr. Moses states, but it is a harder proposition to "sell" the real answer to the prospective buyer. He mentions that washing machines and electric cleaners are sold on both the time-payment plan and for cash, but the difference between the two is hardly sufficient to induce the public to buy for cash. With the tightening up of credit all over the country cash business looks mighty good to any dealer, contractor or public utility, Mr. Moses says, and if this policy of maintaining a cash and time-payment system is to be continued the difference between these two classes of payment should be enough to make the cash proposition really attractive.

ELECTRIC TRUCKS IN SERVICE IN NEW YORK CITY.

With the sale of 525 vehicles since Jan. 1, 1920, the investment in electric trucks in New York City has reached the impressive total of $22,750,000. The number of vehicles sold up to Nov. 1 represents an increase of 548% over the number sold last year.

There are now 4525 trucks of different types in service in New York City, in installations ranging all the way from a single vehicle up to the big fleets of the Ward Baking Co., American Railway Express Co., R. H. Macy & Co., Bush Terminal Co., Gimbel Bros., Cushman's Sons, Inc., Stern Bros., and New York Railways Co.

PERCENTAGE OF UTILITY EMPLOYE-INVESTORS GROWING.

Figures recently compiled show that employes of the utility companies managed by H. M. Byllesby & Co., Chicago, own $1,353,174 par value of the securities of the companies for which they work and other Byllesby organizations. The total number of employes at the utility properties is 4808, of which 1007 are security holders, or 20.9%. The highest percentage of employe-investors is held by the Mountain States Power Co., nearly 80% of whose employes are financially interested in the company, as the result of special efforts made by C. M. Brewer, vice-president and general manager, with headquarters at Albany, Ore. The Oklahoma Gas & Electric Co. is second with 25% and the Tacoma Gas & Fuel Co. is third with 22%. The Northern States Power Co., which has upwards of 12,000 shareholders among its service patrons, has but 14% of the employes owning its stock. Sixteen per cent of the Louisville Gas & Electric Co.'s employes are shareholders, while the San Diego Consolidated Gas & Electric Co. has 16% and the Arkansas Valley Railway Light & Power Co. 13%.

OPERATING PRACTICE

Methods and Problems Embracing Operation and Installation of Power-Plant Equipment and the Distribution of Electrical Energy

AUTOMATIC SUBSTATION FOR LIGHT AND POWER SERVICE.

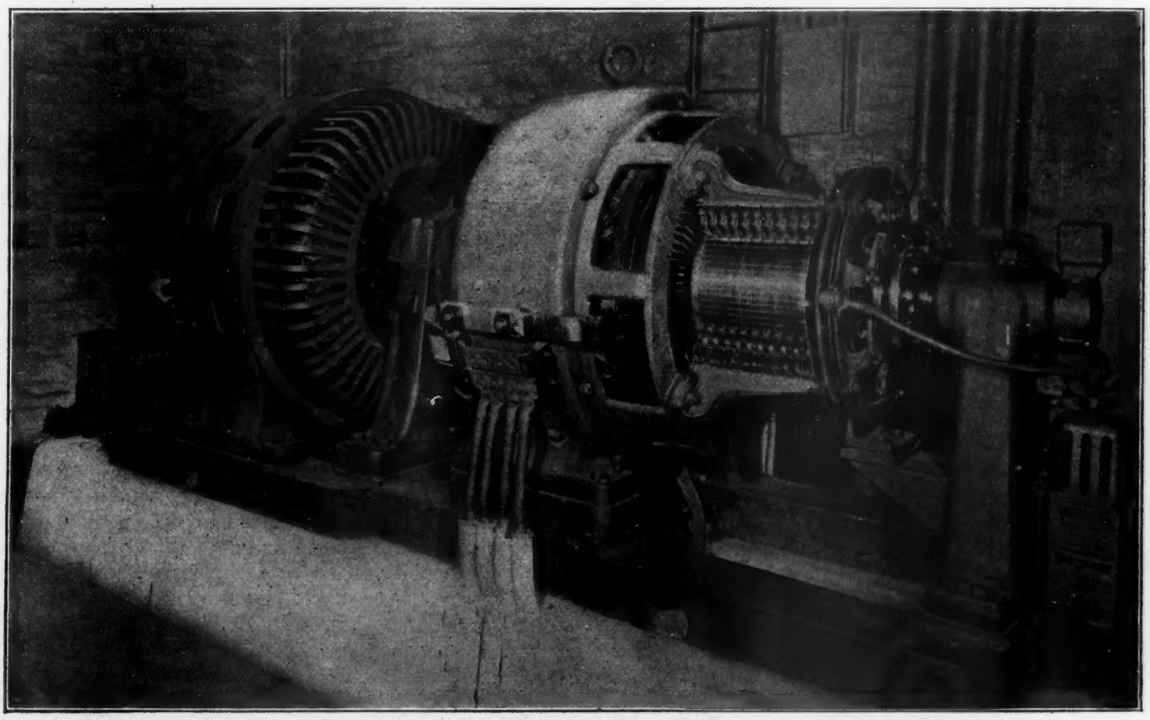
Motor-Genorator Set Supplies Building During Periods of Heavy Demand and Shuts Down During Times of Small Load.

There has recently been placed in operation by the St. Paul (Minn.) Gas Light Co. an automatic substation supplying power to the Edison three-wire distribution system. The equipment in this station, which is of Westinghouse manufacture, consists of a 500-kw., 250/125-volt d-c., compound, commutating-pole, compensated generator directly connected to a 4000-volt, three-phase, 60-cycle, 1200-r.p.m. synchronous motor together with complete automatic switching equipment. This substation is located in the sub-basement of the new Hamm building which houses the new and beautifully modern Capitol theater. Also, in addition to many shops and floors of offices, there is operating in the first basement the St. Paul Amusement Co.

To supply this establishment with service from the central station company's network would have required additions to the capacity in an existing substation and also the addition of copper to the distributing network. In the nearest substation no space was available for the installation of an additional unit. The automatic substation, designed to give to this building a preferred service, solved the problem. During periods of light load the substation is idle, the building being supplied from the regular distribution mains. Below a predetermined voltage the equipment receives a starting impulse from a contact-making voltmeter that puts the substation into service. Operation of the station is continued until the load drops below a predetermined value and remains at or below this value for a given length of time when the station is cut out of service by the action of a small motor-operated timing relay. The system direct-current voltage is above the setting of the contact-making voltmeter during light-load periods so that the station remains idle until the lowering of the network voltage indicates increasing demand.

Reverse-Current Relays Control Connection of Machine to System.

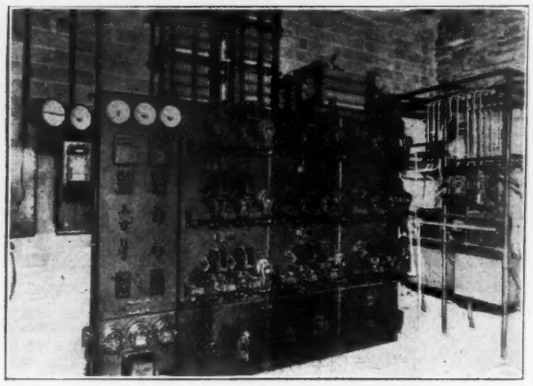
While the substation is in operation it is parallel with the network until the current to it is in excess of one-half the capacity of the machine, when a small amount of resistance is cut into series with the feeder, thus drooping the voltage to effect a dropping of load. This is accomplished by the functioning of reverse-current d-c. relays controlling the operation of the electrically operated contactor switches. When the substation is idle the current inflow to the building from the network is not limited. It is thus seen that this building receives a preferred service. An out-



Motor-Generator Set Installed in Automatic Substation Supplying Light and Power Service.

age on the d-c. network leaves the building to be supplied from the substation. Conversely, an outage of the substation leaves the building to be supplied from the network. This combination establishes good voltage regulation of the service supplied to this location.

Protective features similar to those supplied for railway automatic substations and other features peculiar to this type of equipment afford complete protection to the apparatus. The success of this equipment, as shown by the initial operation, is already assured. It demonstrates



Switchboard Controlling 500-kw. Motor-Generator Substation.

a new application of automatic switching which opens the way to perhaps even a greater field than any that has so far been entered with this class of apparatus.

JOINT POLE-LINE CONSTRUCTION IN CHICAGO.

Appearance, Safety and Economy Result From Common Use of Poles—Paper Before International Association of Municipal Electricians.

By H. B. Gear.
Engineer of Distribution, Commonwealth Edison Co., Chicago.

Joint use of poles has become a standard practice between telephone and electric companies in cities where both maintain distribution plants. The advantages in appearance, safety to the public, and in cost are well known and fully appreciated by all who have had opportunity for observation on a large scale.

It is now 20 years since the city electrician of Chicago called a conference of the pole-owning companies operating in the streets of that city and asked them to co-operate with each other and with the city in making joint use of pole lines wherever there was occasion for any two companies to occupy the same thoroughfare. The city had street-lighting circuits as well as fire-alarm circuits. There was fortunately little duplication of plant by competing electric light or telephone companies to complicate the situation, and the suggestion was generally accepted. The electric company and the telephone company therefore made an informal agreement that each would notify the other of its intention to set new poles and give the other an opportunity to purchase a half-interest if it desired to do so. It was also agreed that where either company desired to extend its service along a route occupied by the other it would arrange with the other company to occupy its poles if of suitable size, or if not to replace them with poles of the proper size for the equipment of both companies, the expense being borne by the incoming party. This policy was also followed with telegraph companies in a few cases where it was convenient to do so.

The telephone lines having been extended to many blocks where no electric service was yet available, most of the electric extensions involved lowering telephone equipment to provide space at the top of the pole for electric circuits, or transferring the equipment to new poles of the proper size and removing the original poles. Where replacement was necessary the cost to the electric company was materially in excess of that of a separate line of poles on the other side of the street or alley. However, the advantages of increased safety and improved appearance were considered to be worth the extra cost, and after ten years of co-operative effort the electric extensions had caught up with the telephone plant and the two proceeded abreast thereafter.

Cost of Work Divided in Development of New Districts.

In going into new subdivisions the work was done by the company which first had applications for service, or if a large amount of work was involved it was apportioned equally by agreement. The system of alleys being quite general, it has not been difficult to avoid using residence and business streets for poles except on streets running at right angles to the general direction of the alleys. On such streets the companies adopted the policy of placing main runs underground at intervals of about four to six blocks, connecting to the pole line at each intersecting alley. This has made possible a condition in which there are less than 5% of the poles on streets with a total of about 110,000 poles in joint use, and the result as regards appearances is quite satisfactory.

The height of a standard joint pole under normal conditions is made up about as indicated in an accompanying table. Northern cedar with 7-in. tops, or Western cedar with 8-in. tops are standard poles for the ordinary line. At corners and junctions poles an inch larger are used. One pole in the middle of each 600-ft. city block is assigned as a transformer pole for that block at the time the poles are set, and other poles are not used for transformers, except that in factory districts power and light transformers are often separate and may have to be placed on separate poles.

Special Allowances Made for Transformers or Cable-Box Poles.

The transformer pole is 40 ft. in length, the extra 5 ft. being assigned to and paid for by the electric company. In a similar way the telephone company takes 5 ft. extra on a cable pole in some cases to provide space for a cable box. In the case of three-phase transformer installations made up of 40-kw. units or larger the transformers are carried on a platform between two poles erected across the alley or on the consumer's premises. Such construction can only be made in a joint line when the telephone circuits are cabled and are carried below the transformer

platform. Poles set out of the line in this way are, of course, not jointly owned.

Guying equipment and the anchor for the pole itself is erected at joint expense. With alley lines side arm construction is used entirely, and in such construction guys must be attached to each cross arm at dead-ends. The arm guys are separately owned and maintained, the anchor being used jointly in many cases.

Where conditions require concrete or plank reinforcement for corner poles this is provided at joint expense as part of the cost of the joint pole. It consists of a collar of concrete about 4 to 6 ins. thick around the pole at the ground line. Where the pull is continuous, as with a self-sustained pole, a block of concrete is also put at the butt of the pole to give increased bearing surface.

Standard Clearance Provided for Safety and Good Service.

The clearance between electric and telephone equipment is that used in all joint agreements with Bell telephone companies—4 ft. This is found sufficient to provide safe working space for the linemen of either company. In cases where city street-lighting wires are carried on joint poles they are placed at the end of the arm with the primary wires, this being a convenient position from which to bring loops down to a lamp. When fire-alarm or telegraph circuits are carried on joint poles they are provided for on a cross arm in the telephone space, thus keeping all communication circuits within the same zone. This arrangement has been found very satisfactory.

The most difficult problem in connection with joint arrangements in general is the desire of the electric company to use its poles for transmission lines at voltages above 5000. The Bell telephone engineers have objected to such an agreement, though contacts are often made by local telephone men on poles carrying circuits of over 5000 volts, presumably without official sanction. Objections of the telephone people are based upon the fear that their fuses will not protect their equipment in case a high-voltage circuit becomes crossed with a telephone wire. There is some reason to believe that the fuses will protect up to about 10,000 volts in most cases, and an agreement has been made in Pennsylvania by which the use of joint poles for circuits up to 13,200 volts may be permitted in cases where it is not practicable to build separate pole lines over different routes. This is felt to be a fair compromise since the high-voltage lines should be on separate poles where separate routes are available, but it is better that there be one pole line if both classes of circuits must be carried along the same route in close proximity to each other. Such situations are becoming increasingly frequent as transmission lines are being extended between neighboring towns along highways both sides of which may already be occupied by pole lines.

Few Crosses Found Between Power and Telephone Lines.

The number of crosses which occur between primary wires and telephone circuits in a system such as that in Chicago is suprisingly small, and the damage is usually confined to a short section of aerial cable the grounded sheath of which may be burned open. Injury to telephone users has occurred, if at all, so rarely that no case can be recalled in the past ten years.

Details of a joint agreement are capable of indefinite expansion, and if not checked involve the expense of a considerable force of record clerks, inspectors and agreement men. The disputes which arise over excessive charges for handling equipment, or for the cost of new work, are eliminated almost entirely in Chicago by the adoption of a set of flat prices for each size of pole, and for the various kinds of operations involved in rearranging equipment. There must be a spirit of co-operation rather than the feeling of suspicion that the other fellow is looking for the best of the deal, which is too often found. With such an atmosphere supported by the higher officials of all companies involved the operation of a joint pole agreement becomes a matter of routine. Very little of the time of the executives and department heads need be taken up as the routine is handled by subordinates who meet daily to go over proposed work with only an occasional point of difference which must be referred to their superiors for adjustment and final disposition.

APPROXIMATE DIVISION OF LENGTH OF STANDARD JOINT POLE.

Section.	Length in feet.
Underground	6
Clearance above surface of ground	20
Telephone equipment	1
Clearance between telephone and electric equipment	4
Electric equipment	3
Above top arm	1
Total length	35

IMPORTANCE OF TIGHT BAFFLE-WALL CONSTRUCTION.

By W. F. Schaphorst.

One subject that is seldom touched upon in connection with boiler management is the baffle wall. A baffle seems to be a very simple part of a boiler setting and therefore worthy of little thought, but that is not the case. Baffles should be correctly designed, correctly placed in the boiler tubes, and they should be leakless. Tests have proven that they cannot be placed haphazard here and there. The volume of the hottest gases usually determines the position of the first baffle encountered. Then, as the gases reduce in volume, due to coming in contact with the tubes and giving off heat, it is clear that the second baffle must be so placed that there will be no reduction in gas velocity. As the gas moves from pass to pass the baffles should be placed closer and closer together.

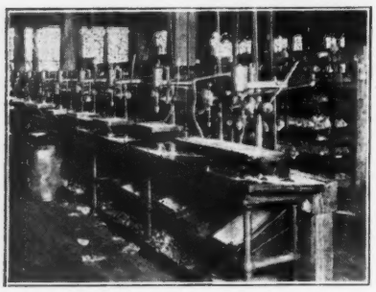
If the baffles leak because of loose or careless construction the hot gases will "short cut" through the baffle and escape up the chimney without giving off the full amount of heat, and the chimney gases will be too hot. Holes in baffles should be stopped up with plastic fire brick. Or, where the baffle is in a bad condition, it might be well to replace the entire structure with a new leakless monolithic baffle of this plastic composition.

NEW APPLIANCES

Newly Developed and Improved Electrical and Mechanical Apparatus, Appliances, and Devices Now Being Placed on the Market

"Two-Way" Cooling-Compound Feed Pump.

A unique system for delivering oil or water to drill presses, lathes, tapping machines, centering machines, screw machines, ets., is used in the Cleveland plant of the Steel Products Co., a large supply being maintained

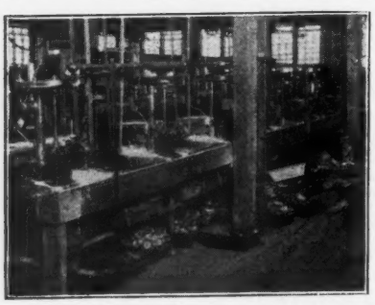


Drill Presses Fitted With "Two-Way" Compound Feed.

whether the machines run forward or in reverse. The pumps used are a new type Ross "Two-Way" centrifugal pump manufactured by the Ross Manufacturing Co. of Cleveland. A single pump provides a ⅜-in. stream for six high-speed drill presses, and another one handles the supply for 21 high-speed drill presses. A third pump handles six tapping machines; a fourth six centering machines, and so on throughout the shop, ranging down to individual installations connected to machine countershafts.

Where a battery of machines is cared for by a single pump a reservoir is placed in the main distributing line with an overflow, thereby providing gravity feed for normal use, and, where pressure is required, the overflow is plugged.

In connection with use on many types of machines for this class of work the ordinary pumps soon wear out and fail to hold their prime. It appears that this was the first centrifugal pump designed to deliver a flow of liquid from the same outlet regardless



Rear View of Drill Presses, Showing Compound Supply Lines.

of direction of rotation of the impeller blade, and from this ability to reverse the name "Two-Way" has been adopted. With machines which run in both directions, such as screw machines, the pump must work in two ways, otherwise the machine will be without cooling compound when running in one direction.

Although this pump is light, compact and neat, it is said to give a large and constant volume of liquid, bringing the stream to the work without pressure. However, if pressure is required, the outlet nozzle is reduced in size and the pump speeded up. The pump is constructed with oilless bearings and graphite-asbestos packing, and no bearings or gears come in contact with the cooling compound. This feature is important as steel chips often mix with the compound, and no bearings or gears can be expected to last long with steel chips being constantly ground through them.

The impeller is composed of four light pieces of vanadium spring steel, and are designed so that there is no end thrust. The pump can be mounted with the base in any one of four positions and is assembled with four cap screws simplifying dissembling. The gear ratio is four to one, giving a high impeller speed when belted to a slow pulley.

Compact Motor-Driven Pump.

A belt-connected motor-driven pump of compact design has been placed on the market by the Humphryes Manufacturing Co., Mansfield, O. The pump is adapted for use where space is limited and yet the construction is said to be rugged and dependable in operation. The front head of the pump and the pump base on which the motor is mounted are cast as one piece. With a 1-hp. motor used for driving the pump the discharge elevation can be 175 ft. and the working pressure 75 lbs. per sq. in.

Ammeters and Voltmeters for Switchboard Service.

Accuracy as well as rugged construction are the features of the type SX switchboard ammeters and voltmeters just placed upon the market by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The movements of these meters are very light, thus assuring the minimum of pivot and jewel wear and obviating injurious effects from shock or vibration. The scales have been prepared to give a pleasing appearance as well as maximum legibility, and all instruments have external zero adjusters.

These instruments operate on the D'Arsonval principle and embody the latest improvements in instrument design. The complete movement, with core and pole pieces assembled, can be removed as a unit, thus facilitating inspection and repairing, and only a slight adjustment is necessary to make new elements operate with the same accuracy as the original ones.

These instruments are finished in dull black. The overall diameter is 7.437 ins., and the depth is 2.406 ins. The weight of each instrument is 9 lbs. If desired, instruments can be furnished with black dials and with the figures, scale marking and pointer in white. Special instruments may be had in this type for use as differential voltmeters for paralleling generators, ground-detector voltmeters or "leakage detectors," double-reading ammeters and volt-

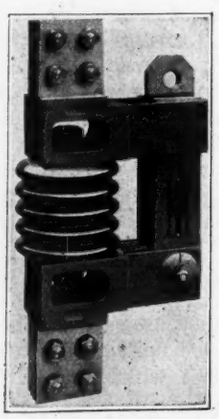
Meter for Switchboard Mounting.

meters, pyrometer millivoltmeters, temperature indicators and speed or frequency indicators.

Delta-Star Bus-Type Disconnect.

The feature of the bus-type disconnecting switch being placed on the market by the Delta-Star Electric Co., Chicago, is that the inclosed section can be easily removed and replaced, as may be seen from the accompanying illustration. The bus-type switch is designed to clamp directly on the bus bar, and is a convenient method of inserting a disconnecting switch.

This switch is made for all current capacities up to 3,000 amperes and for



Bus-Type Disconnecting Switch.

various sizes of bus structure. It is especially adapted for use in installations already constructed without disconnects.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Sterling Lighting & Fixture Co., Buffalo, N. Y., has increased its capital stock from $2500 to $25,000.

Vim Electric & Motor Co., New York City, has increased its capital stock to $20,000 for proposed expansion.

Altorfer Bros. Co., Peoria, Ill., manufacturer of electric washing machines, has increased its capital stock from $400,000 to $3,000,000.

Post-Glover Electric Co., Cincinnati, manufacturer of electrical specialties, plans to increase its capital stock from $120,000 to $720,000.

Washkosh Manufacturing Co., Oshkosh, Wis., manufacturer of domestic washing machines, plans to make additions to its factory this spring.

Trumbull-Vanderpool Electric Co., Litchfield, Conn., manufacturer of electrical products, has increased its capital stock from $125,000 to $200,000.

Eclipse Electric Machine Co., 660 Second street, St. Louis, plans to erect a one-story and basement factory on Thirty-first street at an estimated cost of $17,000.

Leeds & Northrup Co., 4901 Stenton avenue, Philadelphia, has issued bulletin 865 descriptive of its wall-type potentiometer indicator recently put on the market.

United States Light & Heat Corp., Highland avenue, Niagara Falls, N. Y., manufacturer of electric storage batteries, etc., has increased its capital stock from $7,000,000 to $8,500,000.

Wagner Electric Manufacturing Co., St. Louis, has changed the location of its Cincinnati office, in charge of I. W. Pettingill, to 20 East Ninth street, where a service station will also be installed.

American Insulated Wire & Cable Co., Chicago, has purchased a one-story plant at 22nd and Fisk streets, comprising 40,000 sq. ft. The building will be remodeled and used as a copper wire rod mill.

Bussman Manufacturing Co., St. Louis, has distributed a flyer entitled "All Roads Lead to Rome", which sets forth some of the advantages of the "Buss" renewable fuse for protecting electrical equipment.

P. A. Geier Co., Cleveland, has issued a leaflet entitled "He Stuff," the purpose of which is to show the wide practical use of electrical vibrators by men and to refute the common belief that these appliances are simply for the beauty parlor and boudoir.

Northland Electric Supply Co. is the new name adopted by the Triumph Electric Co., 211 South Third street, Minneapolis, Minn. There has been no change in the company, of which H. H. Henley is president; D. E. Ford, vice-president and secretary, and W. H. Vilett, treasurer. The company was established about a year ago and has developed an extensive jobbing trade in the Twin City territory.

Dodge Sales & Engineering Co., Mishawaka, Ind., held its annual sales conference Jan. 18-21. The company reports having experienced a prosperous period in 1920 and is optimistic regarding this year's volume of business.

B. A. Wesche Electric Co., 327 East Sixth street, Cincinnati, manufacturer of motors, etc., has announced that it plans to move to another location Feb. 1 where larger space has been provided for increasing production.

Ross Heater & Manufacturing Co., Buffalo, N. Y., has issued its catalog "F," which illustrates and describes the Ross instantaneous service boiler feed and storage water heaters, condensers, coolers, evaporators, airjector pumps, etc.

Electric Storage Battery Co., Philadelphia, has issued a booklet on the subject of storage batteries, the object of which is to suggest some of the more important ways that "Exide" batteries are serving the industrial and social life of the nation.

National Lamp Works of General Electric Co., Fillmore avenue, Buffalo, N. Y., has construction under way on its proposed two-story machine works, 84 by 322 ft., at 757 East Ferry street, estimated to cost $120,000. The plant will be used for the manufacture of precision and other machinery used in electric lamp production.

Westinghouse Electric & Manufacturing Co. is publishing a new monthly house organ called "The Meter" for its employes at the Newark, N. J., works, where measuring instruments, electric fans and rectigons are manufactured. This publication is similar to the Westinghouse Electric "News," published at East Pittsburgh, and the Westinghouse Machine "News," published at the South Philadelphia plant.

Blaw-Knox Co., Pittsburgh, has secured a contract for a quantity of steel towers for the Nippon Electric Power Co., Osaka, Japan, for use in connection with a new transmission line. The proposed system will extend for a distance of 140 miles, the entire route being handled by steel towers. The lines will carry 160,000 volts, and the system is of the double-conduit type. It is said that the tower contract totals $1,000,000. It is expected to make delivery during 1921.

Beardslee Chandelier Manufacturing Co., 216 South Jefferson street, Chicago, held its annual dinner at the LaSalle Hotel, Jan. 5. In addition to the officers and directors, each department in the office and factory was represented by at least one employe, those present numbering 46. Fred R. Farmer, president of the company, introduced W. R. Abbott, vice-president of the Illinois Bell Telephone Co., and a director of the Beardslee company, who spoke on the anticipated building boom.

Batterman-Truitt Co., Chicago, has issued the seventh edition of its pamphlet entitled "Modern Ventilating Apparatus," which describes the "Autovent" fan motors, blowers and other fan products manufactured by it.

Allis-Chalmers Manufacturing Co., Milwaukee, has issued a booklet which presents in condensed form a description of the company's plants and products and its capacity for producing a great variety of electrical equipment, including apparatus for the generation, transmission, conversion, transformation and utilization of electric power. A large section of the West Allis works is devoted to the manufacture of this equipment, while the entire plant of the Bullock works is utilized exclusively in the production of electrical apparatus.

Electric Furnace Construction Co., Philadelphia, has announced the starting up of a "Greaves-Etchells" electric furnace at the Holmes Foundry Co.'s plant, Port Huron, Mich., for refining and superheating molten cupola metal. It is claimed that the results obtained have been satisfactory and encouraging. It has been found possible by short treatment in this electric furnace to increase the fluidity of the metal and to largely eliminate sulphur. The cupola iron contained 0.102% average sulphur and the finished product showed only 0.023% sulphur. The time taken was about 40 min. Charges of cold scrap have also been run, consisting of 80% cylinder scrap and 20% iron borings. The sulphur in the final product from the cold melted heat was reduced to 0.013%.

Cutler-Hammer Manufacturing Co., Milwaukee, has distributed a leaflet and a folder, known as publications 874 and 880 respectively, both being illustrated with views of C-H space heaters installed in airplane hangars, crane cabs, valve-houses, etc., and giving lists of uses to which these heaters have been put. The heaters are described and tables aid the customer in choosing the approximate number required for any particular installation. C-H space heaters are standardized flat heaters of 500-watt ratings and may be connected to direct or alternating-current light or power circuits in the same manner as adding electric lamps. The value to central stations of C-H space heaters as load-consuming devices is emphasized in a two-color flyer entitled "Easy Seller and Big Revenue Producer." Interesting comparisons are made between the selling prices of space heaters and electric washing machines, as well as the average yearly revenue to the central station obtained from these two devices. The fact is brought out that these heaters bring in a yearly revenue over eight times their cost. Over 100 different uses of these heaters are tabulated on the back of the flyer.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

JAMES R. WERTH has been appointed commercial service manager of the West Penn Power Co., with offices at 14 Wood street, Pittsburgh.

E. A. PALMER has been appointed manager of the railway supply division of the San Francisco office of the Westinghouse Electric & Manufacturing Co.

J. H. FAGG has been appointed local manager of the San Joaquin district, Pacific Gas & Electric Co., San Francisco, to succeed J. W. Hall, who has resigned.

W. D. HAMMER, 508 Traction Terminal building, Indianapolis, Ind., has been appointed district representative of the Automatic Reclosing Circuit Breaker Co. of Columbus, O.

EDWIN M. CUTTING, formerly western manager of the Edison Storage Battery Co. at San Francisco, has been promoted to the position of assistant to the general manager of the company.

FRED E. SCHORNSTEIN, until recently manager of the Red Wing (Minn.) property of the Wisconsin-Minnesota Light & Power Co., has been transferred to the home office in Eau Claire, Wis.

FRANK D. FAGAN, formerly manager of the lamp department of the General Electric Co. at San Francisco, has been appointed vice-president and general manager of the Edison Storage Battery Co., Orange, N. J.

GEOFFREY C. BROWN has been appointed superintendent of manufacturing for the Habirshaw Electric Cable Co., Yonkers, N. Y. He was formerly connected with the Northern Electric Co., Montreal, Can.

FRANCIS J. CHESTERMAN, chief engineer of the Bell Telephone Co. of Pennsylvania, Philadelphia, gave an interesting talk on the subject of "Translating Thought by Electricity" before the local Rotary Club, Jan. 12.

CHARLES HACKEL, formerly connected with the Western Electric Co., New York City, has been appointed chief engineer for the Trenton & Mercer County Traction Co., Trenton, N. J., to handle matters pertaining to power plant and electrical operations.

W. R. MCGOVERN, general manager of the Wisconsin Telephone Co., Milwaukee, has been elected a vice-president of the company. His connection with the company covers a period of 21 years and since February, 1919, he has had charge of the Milwaukee office.

CHARLES S. VOORHEES, formerly assistant telephone sales manager of the Western Electric Co., has accepted a position with the Western Union Telegraph Co. as general purchasing agent. He had been with the Western Electric Co. since November, 1895, his first position with the company being in the cashier's office in New York City. Later he was connected with its switchboard and telephone sales departments and was promoted in 1908 to the position which he recently resigned.

A. S. B. LITTLE, first assistant engineer of the Illinois Public Utilities Commission, has resigned. He has been with the commission since 1914. Mr. Little has accepted a five-year contract with the city of New York to handle all its rate matters before the supreme and federal courts.

HOMER E. NIESZ, who was recently appointed manager of the new industrial relations department of the Commonwealth Edison Co., Chicago, is a member of that group of electric central-station men of the United States

H. E. Niesz.

to whom the term "well known and well liked" may be truthfully applied. A native of Canton, O., Mr. Niesz graduated from Mount Union College in 1886, later moving to Chicago where he engaged in electrical work, gaining practical experience as a wireman. In 1888 he became connected with the Chicago Edison Co., which was succeeded by the Commonwealth Edison Co., and he has been engaged in Chicago central-station work ever since. He was assistant superintendent of construction for some years and thus gained valuable knowledge of electrical work at first hand. In 1899 he became assistant to Louis A. Ferguson, then general superintendent and now vice-president of the company. On July 15, 1909, Mr. Niesz was made manager of the Cosmopolitan Electric Co. of Chicago. Returning to the Commonwealth Edison Co. in 1913 when the Cosmopolitan company was merged into the Commonwealth company, he became secretary of the advisory committee and of the budget and expense committee. On April 1, 1919, he was appointed assistant to Vice-president Ferguson, a position which he has now resigned to take charge of the newly created industrial relations department. Mr. Niesz has been active and effective in many directions. He has been a working member of the National Electric Light Association for years, his monumental Question Box having been presented at the Denver convention of 1905. He was manager of the Chicago Electrical Show for several years and in 1911 was president of the Electric Club of Chicago. In 1913 he was chairman of the Chicago Section of the Electric Vehicle Association and in 1914-15 served as Reigning Jupiter of the Jovian Order. Mr. Niesz has written a number of magazine articles relating to technical subjects and public utility problems.

E. H. BOSS, formerly superintendent of construction, transmission and distribution systems of the American Public Service Co. in Texas and Oklahoma, has joined the sales force of the line materials division of W. N. Matthews & Brother, Inc., St. Louis. He will have charge of the territory previously covered by Warren M. Heim, resigned.

CHARLES B. HART, superintendent of the light and power department of the Indiana Service Corporation, Fort Wayne, Ind., since September, 1917, has tendered his resignation to take effect Feb. 1, when he plans to move to Chicago and engage in another line of business with his brother. In 1902 Mr. Hart became connected with the Indiana Service Corporation as office clerk in the light department, later being promoted to the position of chief clerk. When a sales force was organized he was appointed superintendent of sales, which position he held until made superintendent of the lighting department in 1917. During the many years of his work in the utility field Mr. Hart's efforts toward the best in service have brought numerous compliments to the company.

OBITUARY.

JOHN HENRY EASTWOOD, president of the Eastwood Wire Co., Belleville, N. J., died at his winter home in Florida, Jan. 11, after an illness of several months. He was a member of the Union League Club of New York City, New York Yacht Club, Lotus Club and other organizations. He was 64 years of age.

GEORGE A. CRAGY died Jan. 3 in Worcester, Mass., at the age of 57 years. He was formerly assistant general sales manager of the American Steel & Wire Co. and general sales manager of the National India Rubber Co., wire rope division. Mr. Cragy was a native of Chicago and at one time was president of the Electrical Manufacturers' Club.

DR. WILLIAM ROBINSON died Jan. 2 in Brooklyn, N. Y., where he had resided since 1844. He was the inventor of the electric spot-welding process and various other devices. In 1878 he organized the Union Electric Signal Co., which he later sold to George Westinghouse and his associates. He was a member of the American Institute of Electrical Engineers and other technical organizations.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Bar Harbor, Me.—The Bureau of Yards & Docks, Navy Department, Washington, D. C., has completed plans for the erection of a new radio building at Otter Cliff, Bar Harbor.

Boston, Mass.—In connection with the reorganization of the Boston Suburban Electric Co., stockholders have arranged for the disposition of a security issue, to be used for operations, extensions, etc. It is proposed to form a new organization to acquire the assets of the present company.

Newburyport, Mass. — Considerable electrical and mechanical equipment will be installed by the Consolidated Construction Co., 41 Pleasant street, at its new local stone-crushing plant on State street. The plant will have a capacity of 5000 tons of crushed stone daily, and is estimated to cost about $400,000 with machinery.

North Adams, Mass.—The Trojan Ice Cream Co. will install electric-operated machinery in its proposed new plant, to be erected on a local site, including motors, etc. The factory will be one-story and basement and is estimated to cost about $60,000.

Somerville, Mass. — Electrical and mechanical equipment will be installed in the new two-story factory to be erected by the New England Breakfast Food Co., 29 Newbury street, on Lowell street, estimated to cost about $30,000.

Worcester, Mass. — The American Steel & Wire Co. is planning the erection of a power plant for service for its plants in the Grove Park section.

New Haven, Conn. — Considerable electrical equipment will be installed at the new machine shops of the New York, New Haven & Hartford Railroad Co. at its Cedar Hill yards. The shops will cost about $225,000 with equipment. Construction contract recently has been let to C. W. Murdock, Inc., 505 Grand avenue.

Providence, R. I.—The Narragansett Electric Lighting Co., Turks Head building, is completing plans for the erection of its proposed new service building at Melrose and Russell streets.

Albany, N. Y.—F. C. Huyck & Sons, Third avenue, have had plans prepared for extensions and improvements in the power plant at their felt manufacturing works to cost about $50,000. Griggs & Myers, 110 West Fortieth street, New York, are engineers.

Albany, N. Y. — Governor Miller, taking office Jan. 1, is already giving attention to water power development in the state and has instructed Attorney General Newton to oppose the claims of the federal government over water rights on boundary streams. When this question is settled, it is proposed to develop plans and policies for hydroelectric development work.

Brooklyn, N. Y.—The Kings County Lighting Co., 4802 New Utrecht avenue, will build a new one-story steel coal conveyor system at its plant on First avenue and Fifty-fifth street to cost about $58,000.

Carmel, N. Y.—The Carmel Light & Power Co. has been incorporated with a capital of $25,000 to operate a light and power system here and in other parts of Putnam county. W. C. Smith, E. W. and S. C. Dunning, Carmel, are the incorporators.

Delhi, N. Y.—The Farmers' Light & Power Co. has been incorporated with a capital of $20,000 to operate a local light and power system. The incorporators are R. Archibald, F. W. Thompson and R. S. Marvin.

Granville, N. Y.—A one-story power plant will be constructed by the Telescope Cot Bed Co., 535 East 79th street, New York, in connection with its proposed local factory, 200 by 300 ft., estimated to cost about $100,000. Russell G. Cory, 50 Church street, New York, is engineer.

Johnson City, N. Y.—The water department has commenced the installation of electrically-operated pumping machinery at its waterworks. The total installation will comprise about 1500 hp. Service will be furnished by the Binghamton Light, Heat & Power Co.

Long Beach, Long Island City, N. Y.—Preliminary plans are under way for the construction of a municipal electric power plant. The village council recently made application to the Public Service Commission for permission to construct the station, to be used for other than municipal purposes, as might develop.

Manlius, N. Y.—The common council is having plans prepared for the construction of a new electrically operated pumping station, with pipelines, at the city waterworks, with cost estimated at $30,000. The local water board is in charge; William Burt is chairman.

New York, N. Y.—The New York Edison Co., Irving place and 15th street, has secured the light and power contract for the new Curb Market building, to be located at 78-86 Trinity place. The installation will consist of 1200 lamps and 147 h.p for the operation of pumps, motors and extensive ventilating system.

New York, N. Y.—The New York Edison Co., 130 East 15th street, is considering the erection of a new two-story substation, 40 by 100 ft., at 224-26 East 52nd street.

Stillwater, N. Y.—The Hudson Valley Railway Co. has completed plans for the erection of a one-story car shop and barns, 37 by 125 ft., to cost about $50,000, including electrical and mechanical equipment.

Perth Amboy, N. J. — The city budget for 1921, adopted by the board of aldermen on a first reading, provides an appropriation of $32,000 for street lamps and lighting during the coming year.

Trenton, N. J.—The Trenton & Mercer County Traction Corp. will make improvements and repairs in its local electric power station. The work is in charge of Charles Hackel, chief engineer.

Wilmington, Del.—The Electric Co. of Delaware has been incorporated to operate a central station, the incorporators being H. I. Conklin, J. J. Noel, F. M. Holbrook, and others.

Greensburg, Pa.—Electrical and mechanical equipment will be installed at the proposed new garbage reduction plant to be constructed by the city engineering department at a cost of about $60,000. The city council is arranging for a bond issue for this amount.

Harrisburg, Pa.—A motion providing for the improvement of the Steelton water dapartment was passed by the Steelton council, which authorized that the water board and finance committee make arrangements to have electric appliance installed and to take the place of the steam boilers at the pumping station. George H. Roberts is president of the water board.

Lansdale, Pa.—Although bids have been received for the additional equipment to be installed in the municipal electric plant, the borough council is deferring the award, and no announcement has been made as to when contract will be let, or whether new bids will be asked. A fund of $50,000 is available for the machinery.

Lititz, Pa.—Fire, Jan. 10, destroyed the power house at the plant of the Lititz Planing Mill. The exact loss has not been estimated.

Morrisville, Pa.—Electrical and mechanical equipment will be installed at the proposed sewerage disposal plant to be constructed by the city. Plans for the improvement have been prepared by Thomas F. Bowe, engineer, East Rutherford, N. J. The common council is in charge.

New Hope, Pa.—The Clay Products Corporation of America, Liberty building, Philadelphia, Pa., will construct an electric power plant for general works service in connection with its new brick manufacturing plant at New Hope. The company has inaugurated construction of the main building to be about 800 ft. in length. A railway system will be constructed from the plant to the clay properties. The entire project is estimated to cost about $900,000.

Philadelphia, Pa. — The city has awarded a contract to the Philadelphia Electric Co., Tenth and Chestnut streets, for street-lighting during the coming year at a total cost of $1,355,868, an increase of $38,600 over the amount paid in 1920. The Welsbach Street Lighting Co., Railroad avenue.

has received the contract for furnishing gasoline lighting during the coming year at a price of $623,898.50, an increase of $93,500 over the figures for the year past, due to an advance in price of service from $49.80 to $62.40.

Philadelphia, Pa.—The city council has adopted an ordinance providing for the location of street lights in different parts of the city, with operating service to be provided for in the regular 1921 budget. The extension will provide close to 100 new street lights.

Philadelphia, Pa.—The Electrical Bureau of the city, James F. McLaughlin, chief, is developing plans for the installation of electrical flashlight danger signals at street intersections, as an additional precaution against accidents at night. The proposed lamps will be red and green, with lenses 12 in. in diameter, and of high candlepower. They will be enclosed in an iron case and suspended from poles or extended arms. The system will be so arranged that the red and green will flash alternately at intervals of a few seconds.

Philadelphia, Pa.—The park commission is considering the installation of an approved street-lighting system for important city parks and highways. Investigations and preliminary estimates will be made.

Pittsburgh, Pa.—Fire, Jan. 3, destroyed a portion of the power plant at the works of the Jones & Laughlin Steel Co., Second avenue. No official estimate of the loss has been made.

Pittsburgh, Pa.—The city council has passed an ordinance on first reading providing for the sale of the Northside lighting plant, owned by the municipality, to the Duquesne Light Co. for a consideration of about $380,000. The measure stipulates that the company shall deduct $29,747.14 from the total sale price in full settlement of the city's debt to the corporation up to Dec. 31, 1920, for light, power, etc. The balance, totaling $348,924.19, is to be credited to the city for electric energy used in the future. The company agrees to pay one-half of one per cent on all balances.

Pittsburgh, Pa.—The Penn Public Service Co. has filed application with the Public Service Commission for permission to acquire by purchase 17 electric companies operating in Somerset and Clearfield counties, and to merge the systems with its own. The different companies are: Bloom, Clearfield, Covington, Huston, Karthaus, Pine, Union, Osceola, Addison, Lincoln, Jefferson, Upper and Lower Turkeyfoot, Boswell, Middle Creeek, Burnside and Philipsburg electric light and power companies.

Pittsburgh, Pa.—The West Penn Power Co. has made application to the Public Service Commission for permission to issue stock for $2,500,000, the proceeds to be used for general operations, extensions, improvements, etc.

Reading, Pa.—The city officials are considering placing all wires underground along Penn street, and removing all poles, except ornamental ones, that support street lights.

Scranton, Pa.—Electric equipment and electrically operated machinery will be installed by the Northwestern Mining & Exchange Co., Scranton, in connection with its new mining properties at Cramer. Twin shafts will be constructed and extensive production is proposed.

Wilkes-Barre, Pa.—The council requires the overhead wires on South Main street to be placed underground. The work will start April 1.

Baltimore, Md.—The Consolidated Gas, Electric Light & Power Co., Lexington building, is having plans prepared for the erection of its proposed new electric plant at Monument and Constitution streets. The structure will be one-story, brick and concrete. E. D. Edmondston is general superintendent; A. S. Loizeaux is engineer for the project.

Crisfield, Md.—The board of directors, McCready Memorial Hospital, is having plans prepared by Fyle & Brown, architects, 109 North Dearborn street, Chicago, for the proposed power house at the institution, 42 by 45 ft.

Cumberland, Md. — Considerable electrical equipment, including motors, etc., will be installed in the new extension at the plant of the American Cellulose & Chemical Co., to be one-story, 116 by 400 ft., and estimated to cost about $200,000.

Craddock, Va.—The Craddock Utilities Co. has been incorporated with a capital of $5000. J. B. Duncan is president and M. W. Jackson is secretary.

Kingwood, Va.—The Carleton Mining & Power Co., recently organized, is planning for the erection of a new power plant in this section, for mining and other power service. The company is headed by Warren P. Miller and D. M. Martin.

Scottsburg, Va. — The Big Bend Power Co. has tentative plans under way for the construction of a new hydroelectric power plant on the James river, with total capacity of about 40,000 h.p The company has recently tendered an offer to the city of Washington, D. C., to furnish electrical service "considerably below prevailing schedule." The offer will be investigated by a committee of the Washington chamber of commerce.

Kingwood, W. Va.—The Carlston Mining & Power Co. has plans under way to erect an electric power plant.

Savannah, Ga.—The Savannah Electric Co. will exspend $250,000 on a lighting and street railway system.

Ocala, Fla.—The city will install an electric lighting system on Main street, which will include ornamental posts and fixtures. The mayor is in charge.

Gainesville, Fla. — The common council has arranged for a bond issue of $30,000 for extensions and improvements in the municipal light and power plant.

NORTH CENTRAL STATES.

Canton, O.—The members of the city water commission are investigating the advisability of erecting a central power plant to furnish power to operate the water pumping stations in Canton, and also to furnish light for city buildings and streets. The water commission has a fund amounting to $140,000 which is to be used for erecting a central power plant. Jas. A. Buell is in charge.

Detroit, Mich.—The public lighting commission, in this year's budget, which will be submitted to the city controller, will ask for funds for additional street lights. The statement emphasizes the need for more street lights, and also points out the need for a new power plant, or extensions to the present one.

Holland, Mich.—The common council has granted the Holland City State Bank permission to place five four-arm boulevard light poles adjacent to its building on the corner of River and Eighth streets.

Jackson, Mich. — The Consumers Power Co. is planning extensive improvements at its plant. C. W. Tippy is general manager.

Springport, Mich.—The council is negotiating with the Consumers Power Co. to secure electricity from Albion. An estimate of $22,000 was made for building a transmission line.

Indianapolis, Ind.—The Tippecanoe Power Co. is being organized with a capital of $3,000,000 to construct a hydroelectric generating plant on the Tippecanoe river. John A. Shafer, Indianapolis, is the engineer for the project.

Centralia, Ill.—The Central Illinois Public Service Co. has plans under consideration for the development of this section of the state. The plans carry the establishment of a central plant. D. R. Truax, Mattoon, is secretary.

Freeburg, Ill.—Fuller & Beard, engineers, Chemical building, St. Louis, are making specifications for an electric light and power plant to be erected by the city. Mayor Reinheimer is in charge.

Monmouth, Ill. — The Monmouth Public Service Co. has been granted permission by the state public utilities commission to construct a 13,200-volt electric transmission line between Monmouth and Kirkwood.

Olney, Ill.—The city commissioners are planning to erect an electric lighting plant. Mr. Fritschle is mayor.

Roscoe, Ill.—The council is considering the installation of a street lighting system. The town clerk is in charge.

Springfield, Ill.—A decorative street lighting system is proposed for the area bounded by Lawrence Park, Fayette and West Grand avenues.

Springfield, Ill.—The Central Illinois Public Service Co. has been authorized by the Illinois Public Utilities Commission to purchase the properties of the East Illinois Utilities Co. for $500,000.

Springfield, Ill.—The city council has agreed to purchase the plant of the Springfield Gas & Electric Co., March 10, when the franchise of the company expires.

Springfield, Ill.—The Southern Illinois Light & Power Co. has been authorized to issue $715,160 in bonds and $331,882 in stock.

Ashland, Wis.—Plans are under way for the erection of a "white way."

Darwin, Minn.—Bonds in the sum of $10,000 have been voted for the erection of an electric light and power plant.

Jackson, Minn. — The commercial club has petitioned for authority to establish a "white way" street lighting

system in the business district. Bert Knudson is city clerk.

Jefferson City, Mo.—The farmers residing on the Moreau drive are planning to install electric lights in their homes in the near future. Frank W. Dallmeyer is interested.

Rolls, Mo.—The city has voted to issue bonds in the sum of $25,000 for the installation of additional machinery in the power plant, giving the plant double unit for light and water service.

Lincoln, Nebr.—Fisk & Meginnis, architects, 533 Bankers' Life building, are preparing plans for a power plant building and pumping station. T. Berg is city clerk.

Canova, S. D.—The business men are contemplating purchasing and improving the Howard-Canova electric transmission line. S. H. Butler is in charge.

Worthing, S. D.—The town board has petitioned for an issue of bonds for the construction of a transmission line to Harrisburg, to connect with lines from Sioux Falls. The cost is estimated at $12,000.

SOUTH CENTRAL STATES.

Dothan, Ala.—The Houston Power Co. will construct a dam for the development of electric power and light current on the Little Chootawhatchie river.

Arkadelphia, Ark.—The Arkansas Light & Power Co. will improve its light and water systems. H. C. Couch is president.

Hindsville, Ark.—The city has plans under way for the installation of a street lighting system. The mayor is in charge.

Vinita, Okla.—Electrical and mechanical equipment will be installed in the new purification plant to be constructed by the City Council at an estimated cost of $460,000. The works will include a liquid chlorine department, sand filter system, etc.

El Paso, Tex.—The city council is considering preliminary plans for the establishment of a hydroelectric power plant in the vicinity of the Elephant Butte dam. It is planned to construct a large generating station, with a number of substations, and transmission system to reach the city. The work is estimated to cost in excess of $3,000,000. Charles Davis, mayor, is interested in the project.

Pecos, Tex.—The Pecos Power & Ice Co., recently organized, will remodel and improve an existing power plant for its initial station. The work will include the installation of considerable machinery for increased capacity. A transmission system from Pecos to Barstow, about 20 miles, will also be constructed. J. W. Crowdus, El Paso, is engineer for the company.

Lingleville, Tex.—Efforts are being made to secure a power and electric lighting plant. Lingleville is located 11 miles west of Stephenville.

WESTERN STATES.

Lakeview, Wash.—A Mushen and G. D. Coonemiller have made application to the Federal Power Commission for permission to develop 1000 hp. by dams in Deep creek and Camas creek with pipe lines converging to same power house.

McGowan, Wash.—H. S. McGowan has filed two applications with the Federal Power Commission for developments on the Deschutes river at Metolius and reclamation sites.

Ashland, Ore.—At a meeting of the chamber of commerce, Mayor Lamkin suggested that the move for a municipal power plant, recently launched by the water committee of the city council, be referred to the voters.

Portland, Ore.—The Portland Railway, Light & Power Co. has made application to the Federal Power Commission for a license to erect a dam and power house at Oak Grove on the Clackamas river.

Los Angeles, Cal.—Karl Brehm, president of the Constant Angle Arch Dam Co., has received a contract for the design of the Pacoima Canyon dam. The dam will be 400 ft. high and will cost $1,500,000.

Los Angeles, Cal.—The Los Angeles Gas & Electric Corp. is having plans prepared for enlargements and extensions to its plants and distribution system. Between $4,000,000 and $5,000,000 will be spent. Wm. Baurhyte is vice-president.

CANADA.

Montreal, Can.—The Manouan Pulp & Paper Co., Ltd., of which J. P. Anglin is president, has plans under way for the construction of a new hydroelectric power plant at Allards Falls, St. Maurice river, Quebec, in connection with a new pulp mill in this section. Charles E. Eaton, Sherman building, Watertown, N. Y., is engineer for the project. The initial station will have a capacity of about 9000 hp., and with pulp mill and machinery is estimated to cost close to $1,000,000.

St. Johns, New Brunswick.—The Madawaska Light & Power Co. is having plans prepared for a power plant on Green river to develop from 2000 to 2500 hp.

INCORPORATIONS.

Greenwich, Conn.—New England Products Co. Capital, $300,000. To manufacture electrical equipment, etc. Incorporators: G. G. Knowles, E. L. Marsh, C. F. Hoyt, 307 Atlantic street, Stamford, Conn., and others.

Brooklyn, N. Y.—Adelphi Lighting Fixture Co. Capital, $5000. Incorporators: L. Barnett, 1379 St. John's place, Brooklyn; J. Fenner, L. Newman and others.

Lexington, Ky.—Lexington Storage Battery Manufacturing Co. Capital, $25,000. To manufacture storage batteries and other electrical products. Incorporators: L. B. Speyer, M. B. Davis, H. Greenbaum and others.

Malden, Mass.—G. E. Bliss, Inc. Capital, $15,000. To manufacture electric heating appliances. Incorporators: G. E. Bliss, Lewis J. Sage, and Chester T. Bliss, 80 Florence street.

Augusta, Me.—Yarmouth Electric Co. Capital, $25,000. To manufacture and deal in electrical products. Incorporators: Harold D. Jennings, Walter S. Wyman and E. A. Ballantyne.

Buffalo, N. Y.—Buffalo Electric Sun Signs, Inc. Capital, $45,000. To manufacture electrically operated outdoor display signs. Incorporators: B. M. Olcott, H. D. Gardner and V. H. Clymer, Syracuse, N. Y.

New Rochelle, N. Y.—The Farrell & Jarvis Corp. Capital, $20,000. To engage as electrical contractors. Incorporators: J. and F. V. Farrell, and C. V. Jarvis.

New York, N. Y.—Renfro-Smith Co. Capital, $15,000. To manufacture motors and electrical products. Incorporators: H. S. Smith, J. F. Renfro and S. M. Cohen, 1834 Broadway.

Bayonne, N. J.—Globe Electric Co. Capital, $5000. To engage as electrical contractors. Incorporators: David R. and E. T. Thomas, and Matthew W. Ryan.

Philadelphia, Pa.—Morris Manufacturing Co. Capital, $100,000. To manufacture electric lamps and other kindred specialties. Incorporators: F. R. Hansell, J. Vernon Pimm and E. M. MacFarland.

FOREIGN TRADE.

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electric Fans (34,280).—An inquirer in India desires to receive information and quotations on ceiling and desk fans for 220 to 240 volts, direct current, and on wire and cable for house work. The wire should be rubber covered, made in accordance with

Electrical Materials (38,282).—A mercantile firm in Bulgaria desires to secure an agency for the sale of electrical materials. Quotations should be given c. i. f. Varna or Bourgas. Reference.

Electrical Apparatus (38,283).—A merchant in Canada desires to purchase an electric-lighting plant for a country house, automatic without storage battery, of not less than 1500 watts. Quotations should be given f. o. b. point of shipment. Payment to be cash. Reference.

Electrical Fittings (34,288).—A mercantile firm in Australia desires to secure exclusive agencies from manufacturers for the sale of electrical fittings of all kinds. Catalogs are requested. Quotations should be given f. o. b. New York City or c. i. f. Australian port. References.

PROPOSALS.

Lyndhurst, N. J.—The board of education will receive bids for electrical equipment, ventilating apparatus, etc., until 8 p. m., Feb. 18, in connection with the erection of the proposed school building at Stuyvesant and Kingsland avenues. A. L. Vegliante, Garfield, N. J., is architect. Dominick J. Livelli is district clerk.

Manitowoc, Wis.—The city will receive bids for an ornamental street lighting system on Eighth street and on Washington street. Address Northwest Electric Apparatus Co., 942 Security building, Minneapolis, or Arthur H. Zander, city clerk.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Public Utilities Need Higher Investment Returns.

W. S. Barstow, who is actively connected with several public service companies, recently made the following statement on the public utilities situation:

"For the last five years public service companies in this country have had all they could do to meet the constantly increasing costs of labor, coal and material by getting rate increases that enabled them merely to exist and continue as solvent concerns. It has been impossible, for either the companies or the commissions to give full consideration to some of the broad questions that now must be fairly passed upon by the commissions if these companies are to continue to serve and satisfy the demands of the public as to extensions, etc.

"It would have been possible before the European war to sell securities on the following basis: bonds 5½%, preferred stock 7% and common stock 10%. Total cash necessary to pay interest and dividends on these securities would average about 7%. In addition to this the company would have to earn at least 2% more for contingencies and 2% for depreciation, or a total of 11% on the actual capital invested. This, however, would be predicated upon a company's financing all construction by the sale of securities.

"Now, in addition to these factors, the companies find a very radical change in the security market. The same character of bonds that must now be sold on an 8% to 8½% basis could have been sold before the war on a 5½% basis. This means a correspondingly higher return on the stock. In other words, if 11% was fair before the war it would require at least 13½% today.

"Under present regulations, it is questionable whether utility companies can be properly restored and be in a position to expand unless for a period of time a return of at least 15% is allowed upon investment. With this return properties of the better class can probably begin to recover, set up a proper reserve for contingencies and depreciation and pay proper returns to stockholders."

New Bond Issue of Mississippi River Power Co.

The Mississippi River Power Co., a Stone & Webster company, owning and operating one of the largest hydroelectric plants in the world, has sold to a syndicate of bankers, of which Kidder, Peabody & Co. and Stone & Webster are managers, $3,600,000 fifteen year 7% sinking fund gold debentures, dated Nov. 1, 1920, and due Nov. 1, 1935, at 91⅜ and interest, to yield 8%. This issue is now offered to the public. The proceeds of these debentures will retire all indebtedness other than the $19,075,400 outstanding first mortgage bonds. During the past three years the company out of current earnings has reduced its indebtedness by over $1,400,000 and added to plant about $500,000.

Earnings and expenses for the twelve months ending Dec. 31, 1920, were as follows:

Gross earnings		$2,827,963.85
Operating expenses and taxes		638,622.95
Net earnings		$2,189,340.90
Interest on $19,075,400 outstanding first mortgage bonds	$953,770	
Interest on $3,600,000 debentures now offered	252,000	
		1,205,770.00
		$983,570.90

Offering of Southwestern Power & Light Co. Gold Notes.

Bonbright & Co. and Halsey, Stuart & Co., Chicago, are offering a new issue of $1,250,000 Southwestern Power & Light Co., twenty year 8% bond secured gold notes, series "B," dated Jan. 1, 1921, and due Jan. 1, 1941, at 97 and interest, to yield about 8.30%. The Southwestern Power & Light Co. owns or controls companies operating in the richest and most rapidly growing sections of Texas. A diversified public utility service is furnished in 122 communities, including many important cities, among them Ft. Worth, Waco, Denison, Wichita Falls, El Paso and Galveston.

Northern Ohio Electric Corp. and Subsidiaries.

	1920.	1919.
November gross	$ 852,221	$ 847,356
Net earnings	200,277	277,375
Surplus after fixed charges	5,075	104,384
Deficit after preferred dividends	24,924	*74,384
Eleven months' gross	10,161,183	8,375,458
Net earnings	2,914,905	2,808,679
Surplus after fixed charges	821,225	961,582
Balance after preferred dividends	491,225	631,582

*Surplus.

United Gas Improvement Co. Bonds.

The United Gas Improvement Co. of Philadelphia has sold $7,500,000 of 8% two year coupon notes to Drexel & Co. of Philadelphia and the Harris Trust and Savings Bank. The notes, which mature Feb. 1, 1923, are being offered at 99.45 and interest, yielding about 8.30%.

Bloomington & Normal Railway & Light Co. Stocks and Bonds.

The Illinois Traction System, Bloomington, Ill., has petitioned to the Illinois Public Utilities Commission for the right to sell stocks and bonds for the Bloomington & Normal Railway & Light Co., as follows: $93,000 in bonds, $108,000 preferred stock and $72,000 first and general mortgage bonds.

The Western Union Telegraph Co., Inc.

For Twelve Months Ended Dec. 31, 1920.	
Gross revenues, including dividends and interest	$122,357,437.00
Maintenance, repairs and reserves for depreciation	$ 16,477,403.00
Other operating expense, including rent of leased lines, taxes and employes' income participation	91,763,434.00
Total expenses	$108,240,837.00
Balance	$ 14,116,600.00
Deduct interest on bonded debt	1,331,850.00
Net income	$ 12,784,750.00

Issue of Southwestern Power & Light Co. Notes.

An issue of $1,250,000 Southwestern Power & Light Co. 8% bond secured notes, due Jan. 1, 1941, has been offered to the public by Bonbright & Co. and Halsey, Stuart & Co., at 97 and interest, yielding 8.30%.

Northern Texas Electric Co. and Subsidiaries.

	1920.	1919.
November gross	$ 330,885	$ 300,245
Net earnings	93,638	116,587
Surplus after charges	68,891	92,441
Twelve months' gross	3,937,420	3,307,825
Net earnings	1,442,851	1,308,624
Surplus after charges	1,143,656	1,009,697

Dividends.

	Term.	Rate.	Payable.
Conn. Ry. & Ltg. com.	Q	1.125%	Feb. 15
Conn. Ry. & Ltg. pf.	Q	1.125%	Feb. 15
El. Bond & Share com.	Q	2%	Jan. 15
El. Bond & Share pf.	Q	1.50%	Feb. 1
Ft. Worth Pr. & Lt. pf.	Q	1.75%	Feb. 1
Idaho Pr. pf.	Q	1.75%	Feb. 1
Lowell Elec. Lt.	Q	$2.50	Feb. 1
Pub. Serv. Invest. pf.	Q	$1.50	Feb. 1

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities.	Div. rate. Per cent.	Bid Jan. 11.	Bid Jan. 18.
Adirondack Electric Power of Glens Falls, common	6	12	13
Adirondack Electric Power of Glens Falls, preferred	6	71	71
American Gas & Electric of New York, common	..	95	94
American Gas & Electric of New York, preferred	6	33	36
American Light & Traction of New York, common	..	82	79
American Light & Traction of New York, preferred	6	71	74
American Power & Light of New York, common	4	42	42
American Power & Light of New York, preferred	6	61	62
American Public Utilities of Grand Rapids, common	..	7	8
American Public Utilities of Grand Rapids, preferred	7	17	18
American Telephone & Telegraph of New York	..	100	102
American Water Works & Elec. of New York, common	..	1	2
American Water Works & Elec. of New York, particip	7	4½	4½
American Water Works & Elec. of New York, 1st preferred	..	37	41
Appalachian Power, common	..	2	2
Appalachian Power, preferred	7	18	17
Cities Service of New York, common	+extra	237	243
Cities Service of New York, preferred	6	64	65
Commonwealth Edison of Chicago	8	103	102
Comm. Power, Railway & Light of Jackson, common	..	13	14
Comm. Power, Railway & Light of Jackson, preferred	6	36	34
Federal Light & Traction of New York, common	..	6	6
Federal Light & Traction of New York, preferred	..	45	42
Northern States Power of Chicago, common	..	35	38
Northern States Power of Chicago, preferred	ex.div.7	77	78
Pacific Gas & Electric of San Francisco, common	..	48	48
Public Service of Northern Illinois, Chicago, common	7	57	58
Public Service of Northern Illinois, Chicago, preferred	6	75	72
Standard Gas & Electric of Chicago, common	..	12	12
Standard Gas & Electric of Chicago, preferred	8	32	34
Tennessee Railway, Light & Power of Chattanooga, common	..	1	1
Tennessee Railway, Light & Power of Chattanooga, preferred	6	1½	1½
Western Power of San Francisco, common	..	21	20
Western Union Telegraph of New York	extra	78	80
Industrials—			
Electric Storage Battery of Philadelphia, common	4	98	98
General Electric of Schenectady	8	117	115
Westinghouse Electric & Mfg. of Pittsburgh, common	7	42	42